Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

UNITED STATES
DEPARTMENT OF AGRICULTURE
CIRCULAR No. 536

Washington, D. C. November, 1939

THE ANNUAL LESPEDEZAS AS FORAGE AND SOIL-CONSERVING CROPS

By

A. J. PIETERS
Formerly Principal Agronomist
Division of Forage Crops and Diseases
Bureau of Plant Industry
and
Section of Agronomy and Range Management
Division of Conservation Operations
Soil Conservation Service

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - - - - - Price 10 cents

CIRCULAR No. 536 NOVEMBER, 1939
UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

THE ANNUAL LESPEDEZAS AS FORAGE AND SOIL-CONSERVING CROPS[1]

By A. J. Pieters, formerly *principal agronomist, Division of Forage Crops and Diseases, Bureau of Plant Industry,* and *Section of Agronomy and Range Management, Division of Conservation Operations, Soil Conservation Service*

CONTENTS

Page
Introduction 1
Varieties 2
Geographical range and history 5
Climatic adaptation and drought resistance 7
Acreage of lespedeza 9
Culture 10
  Lime and fertilizers 10
  Inoculation 14
  Method of seeding 14
  Time to seed 15
  Rate of seeding 15
  Germination 16
The lespedezas for grazing 17
  Carrying capacity 18
  Time to graze 19
  Permanent pasture 20
  Rotation pasture 20
  Lespedeza with small grain 20
  Lespedeza in legume mixtures 22
  Korean lespedeza in an all-year pasture system 22
  Winter grazing 23
Lespedeza for hay 23
  Where hay is produced 23
  Time to cut lespedeza 25
  Curing 26

Lespedeza for hay—Continued.

  Feeding results 26
  Chemical analysis 27
  Yields 29
  Hay grades 30
  Leaf meal 30
Weeds in lespedeza 32
Seed production 33
  Seed yields 35
  Harvesting 36
  Recleaning 37
  Appearance of seed 38
  Weight of seed and number per pound 39
Diseases 39
Insects 40
Lespedeza in rotation 40
  Effect of lespedeza on soil productivity 40
Lespedezas in orchards 43
Erosion control 43
Use of annual lespedeza in the soil conservation program 49
  Use in strip cropping 51
  To protect meadow waterways and terrace flow lines 52
  Use in pastures 53
Literature cited 53

INTRODUCTION

The evils of continuous row-crop farming are written for all to read in the worn, eroded corn and cotton fields of the South and wherever soil-depleting crops have been grown year after year. Now that the public conscience has been awakened to these evils, a general interest centers in the crop or crops that will control further loss and improve soils that have been damaged. The ideal plant for this purpose is one that can also be utilized in some other way. Under extreme conditions it may, of course, be necessary to use a plant that will hold the soil even if it can serve no other purpose, but obviously the plant that will conserve the soil and at the same time yield an income is the plant to grow. The lespedezas[2] are unrivaled in this special field.

---

[1] Contribution from Soil Conservation Service and Bureau of Plant Industry.

[2] As used in this circular the terms "lespedeza" and "lespedezas" refer to any variety of annual lespedeza. For a discussion of perennial lespedezas see Pieters (*33*).[3]

[3] Italic number in parentheses refer to Literature Cited, p. 53.

In that part of the United States lying south of the Potomac, the Ohio, and the Missouri Rivers and to some extent north of that line, and east of Kansas and Oklahoma, lespedeza serves the dual role of a forage and soil-conserving crop. It is widely used in the soil conservation program and with proper attention to management and to its use in combination with other crops will undoubtedly be even more widely used in the future.

It should be made clear that the lespedezas are not competitors of the clovers or of alfalfa. Their principal field of usefulness begins where that of the clovers leaves off—at a certain ill-defined level of soil productivity or where, for reasons not connected with soil productivity, the clovers are not well adapted. For example, on certain productive lands in Indiana and Illinois the clovers repeatedly failed to make a stand, whereas Korean lespedeza succeeded. It is probable that heavy growths of grain so weakened the clover that it perished from heat and drought after the grain harvest. Lespedeza was able to withstand these conditions. Again, where a 1-year rotation of grain and legumes is desirable, lespedeza is better adapted than clover and can serve a useful purpose even on soils otherwise suited to clover.

By and large, however, lespedezas are suited to soils of a lower fertility level than clovers, and it is on such soils that they are paramount. In the region south of the Potomac, the Ohio, and the Missouri Rivers and east of Kansas and Oklahoma, the acreage of low-fertility vastly exceeds that of high-fertility land. Parts of this region are badly eroded and are still eroding. There is need for a legume that will control this erosion, build up the land, and at the same time yield the farmer some income. The annual lespedezas fill this need. No other legume has a more important part over so wide a territory in checking erosion and in gradually improving worn land with the least outlay of cash. At the same time, lespedeza will pay its way in hay, pasturage, and seed.

VARIETIES

The genus *Lespedeza* includes some 125 species of which only 2 are annuals. Both of these species *L. striata* (Thunb.) H. & A. and *L. stipulacea* Maxim. have been introduced into the United States from the Orient. *L. striata* has been in this country for about 100 years while *L. stipulacea* was introduced from Chosen (Korea) in 1919. Named varieties of each species are now more or less widely distributed. Under *L. striata* are to be distinguished the common lespedeza,[4] Kobe,[5] and Tennessee 76, and under *L. stipulacea* are Korean, Harbin, and the early Korean U. S. D. A. 19604.

All the annual lespedezas produce two kinds of flowers—one, which is readily seen, has purple or bluish petals; the other, which is inconspicuous, has no petals. Both kinds of flowers may occur in the same cluster and both produce seed. The inconspicuous flowers are the more numerous and are undoubtedly self-fertile. It is not known whether the conspicuous flowers are self- or cross-pollinated, but the available evidence indicates that they are usually selfed.

---

[4] The term "common lespedeza" has been used as synonymous with *Lespedeza striata*. It is better to use the term "common lespedeza" to designate the unselected form of this species growing spontaneously throughout its range as distinguished from the selected varieties, Tennessee 76 and Kobe. The term "Korean" will be used to designate the unselected form of *L. stipulacea;* selected forms will be designated by special names.

[5] Pronounced Ko-be.

Common lespedeza is a slender plant that is usually prostrate in growth except in dense stands and has small leaflets and purple flowers. In common with all the other varieties it begins to grow late in spring, grows most rapidly in midsummer, seeds in late summer or early fall, and is killed by the first severe freeze.

Kobe is a larger, coarser plant of somewhat more erect habit and has larger leaves and distinctively larger seeds. Its period of growth is about the same as that of common. Tennessee 76, a late-maturing variety, is erect in habit, but the leaves, flowers, and seeds are like those of the common. It makes a larger growth than the common and is consequently better suited for hay production.

L. stipulacea differs from *L. striata* in having a much broader leaflet and a broad stipule (fig. 1). The growth is larger and coarser and except in thick stands the habit is prostrate. The seeds are very different from those of common lespedeza. The habit of seed production is also distinctive, the seed is borne in the leaf axils at the tips

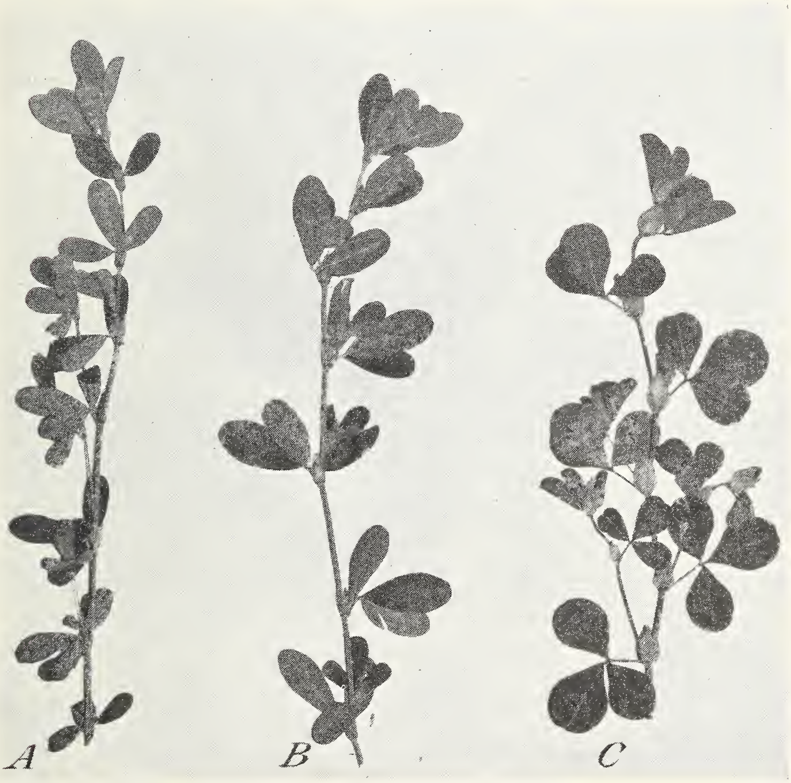

FIGURE 1.—Branches of common (*A*), Kobe (*B*), and Korean (*C*) lespedezas. The leaflets of Kobe differ from those of common only in that they are larger. The leaflets of Korean are broader and have prominent stipules.

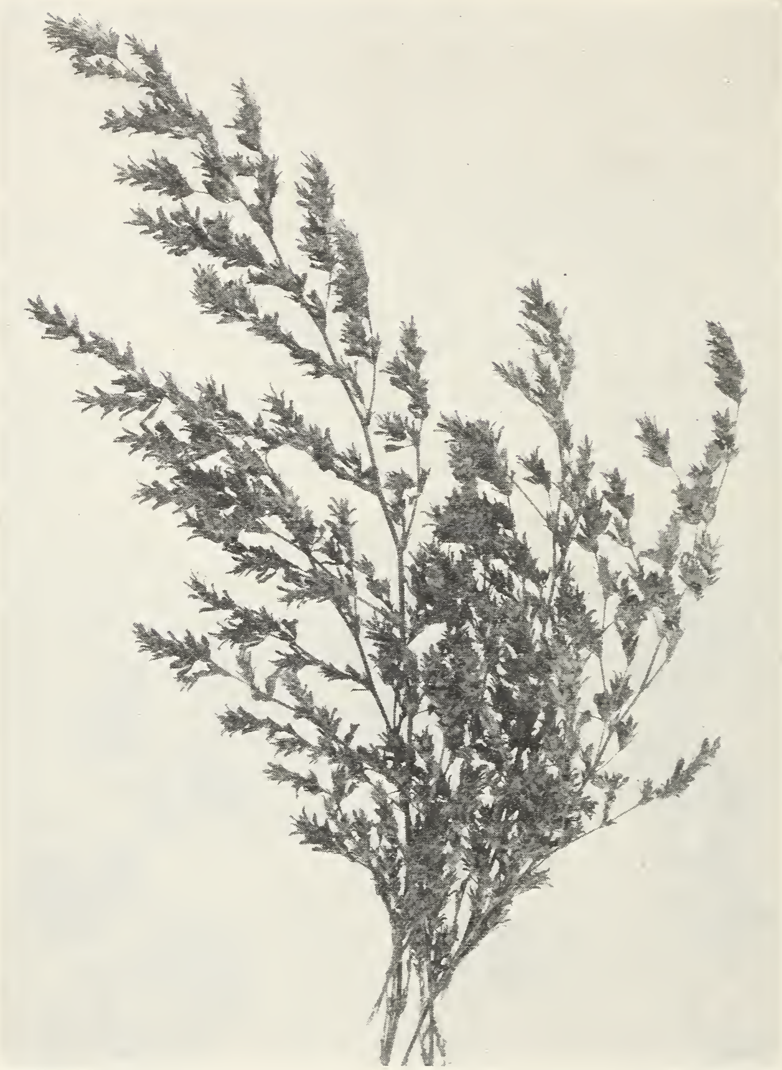

FIGURE 2.—A fruiting branch of Korean lespedeza. Note conelike shape of the ends of the branches, due to the forward folding of the leaves.

of all branches and not along the stem as in the common. As the plants approach maturity, the leaves at the ends of the branches turn forward and become folded together in a small cone (fig. 2). Seed ripens about a month earlier than that of the common lespedeza; therefore, the species is suited to a more northern habitat.

Harbin lespedeza resembles Korean in the shape of leaflets, in seeds, and in seeding habits, but it matures much earlier. Seed has matured at Winnipeg, Canada. Unfortunately, the variety makes so little growth in broadcast stands that its usefulness is doubtful.

Early Korean 19604 resembles the standard Korean, but it matures seed 2 weeks earlier; this enables it to mature seed and volunteer farther north than the standard Korean. It appears to be subject to a bacterial disease that limits is usefulness. Fortunately, the disease is not always present or active and appears to be less common in the northern part of Iowa and Illinois than in Missouri.

GEOGRAPHICAL RANGE AND HISTORY

Some variety of lespedeza will produce seed from the Gulf of Mexico to the northern border of Illinois, and Harbin will produce seed up to the northernmost limits of the United States. Moisture is the limiting factor toward the west. The annual lespedezas are not useful farther west than about the eastern fourth of Kansas The varieties of *Lespedeza striata* are best suited to the area from northern Tennessee to the Gulf, though there is some common and a little Kobe north of this line, some common occurring as far north as Indianapolis, Ind.

Kobe and Tennessee 76 are late-maturing varieties. The range of Kobe is from southern Mississippi to southern Illinois and from eastern North Carolina to western Tennessee. It is also popular in some parts of the Piedmont area of South Carolina and Georgia. Tennessee 76 is chiefly grown in eastern and central North Carolina and in western Tennessee.

Lespedeza stipulacea (Korean) matures earlier than *L. striata* and reaches its best development in a zone including Virginia and North Carolina on the east, and eastern Kansas and eastern Oklahoma on the west. It is also suited to the Piedmont area of South Carolina, Georgia, and Alabama and extends north to central Illinois and Indiana. Korean is at present more extensively used than any other lespedeza. Early Korean 19604 is a reliable seed producer to the northern limit of Illinois but is not suited to the southern range of the species. Harbin will produce seed to the northern limits of the United States, but its dwarf habit makes it of little value and it is wholly unsuited to any area south of Michigan.

The early history of lespedeza has been set forth by Pieters (*32*). The common lespedeza has long been in the United States, the earliest record being from Monticello, Ga., in 1846. That its good qualities were early appreciated is shown by the agricultural literature of the sixties. A number of articles from residents of North Carolina, South Carolina, and Georgia during that period extolled the virtues of the new "clover." It spread to Alabama and Mississippi by 1867 and was well known in parts of Tennessee in 1870. In 1880 it was being cut for hay in Louisiana, and by 1887 it was established near Fredericksburg, Va. Its rapid spread through the Gulf States was no doubt due to its prolific seeding and to the movement of armies during the War between the States. It had moved into Kentucky in 1893 and by 1912 had become established in southern Indiana. It is now known to be naturalized as far north as Indianapolis.

Kobe was brought to the United States by an explorer of the United States Department of Agriculture in 1920, and the first seed crop was grown at Hartsville, S. C. Tennessee 76 was introduced

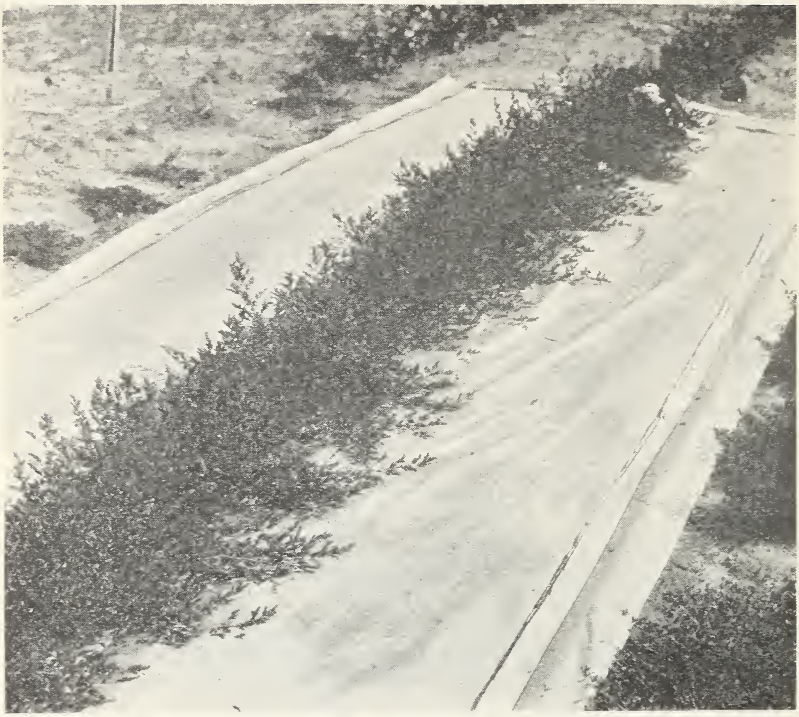

FIGURE 3.—The first Korean lespedeza grown in United States.

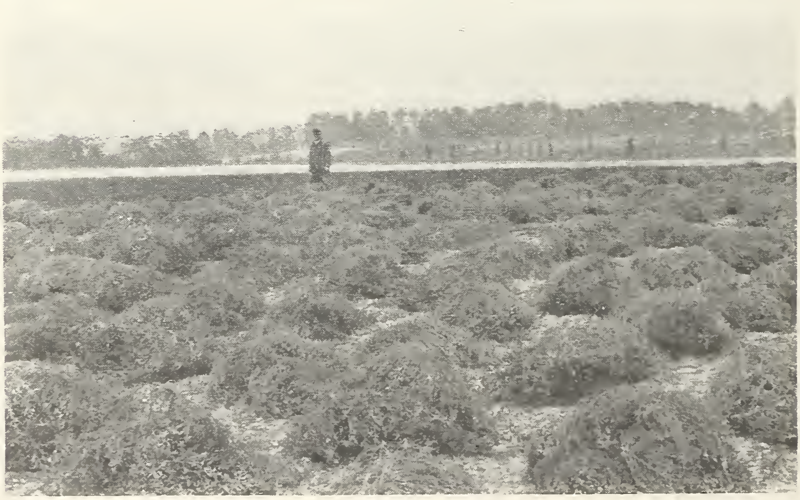

FIGURE 4.—First seed crop of Korean lespedeza at Arlington Experiment Farm, Va.

by Essary (*6*) of the University of Tennessee in 1915. It was the best of a number of selections with which he was working at that time.

Korean lespedeza was sent to the United States in 1919 by Ralph Mills, a medical missionary in Chosen (formerly Korea). The first seed was harvested at the Arlington Experiment Farm, Va., in 1921 (*34*) (fig. 3). A small distribution was made in 1922 and a more extensive one in 1923 (fig. 4).

CLIMATIC ADAPTATION AND DROUGHT RESISTANCE

Lespedezas are hot-weather plants, and most of them will not bloom and seed under a long day. All are slow to begin to grow in spring though the varieties of *Lespedeza stipulacea* begin to grow earlier than those of *L. striata* (fig. 5). All continue to grow until frost except *L. stipulacea*, which stops growing with maturity of the seed. This fact makes *L. stipulacea* unsuited to the extreme South. None of the annual lespedezas withstand severe frosts. Seedlings that start during warm days in late winter may be killed by a late freeze; mature plants are cut down by the first sharp frost in fall.

Lespedezas are strongly drought-resistant but during prolonged drought little, if any, growth is made. The effect of drought on the different varieties will depend somewhat on the stage of growth reached. If maturity is not too far advanced late rains will revive growth and fair to good yields may be secured. The annual lespedezas, especially Korean, are much more drought-resistant in the early stages than are alfalfa or the clovers. In Kentucky in 1930

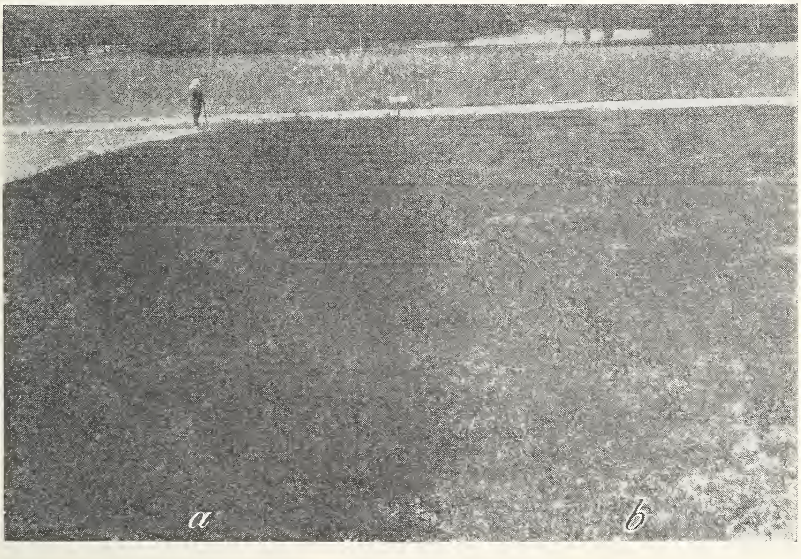

FIGURE 5.—Korean (*a*) begins to grow earlier than Kobe (*b*). These stands were photographed at Arlington Experiment Farm, Va., June 3, 1925. There was a good stand of Kobe in July.

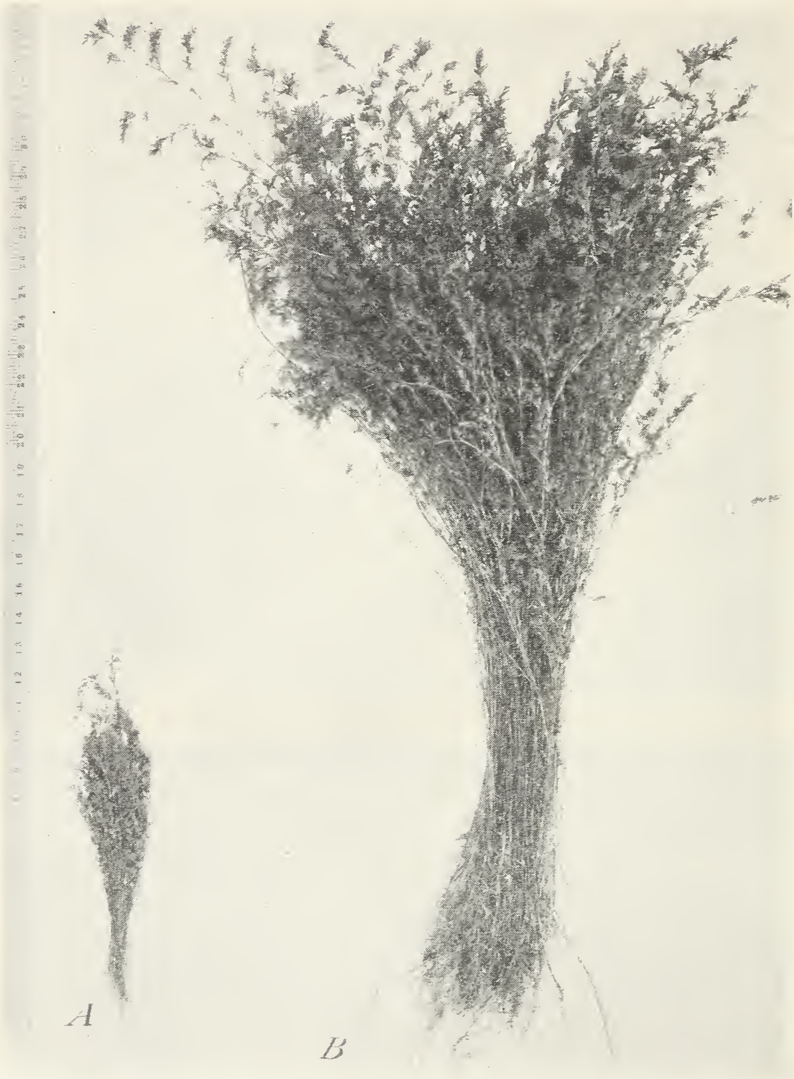

FIGURE 6.—The two bunches of Korean lespedeza shown grew in the same kind of soil and only a few feet apart. Because of difference in topography *B* had an abundance of moisture and grew to a height of 30 inches, whereas *A* had little moisture and grew to a height of only 8 inches. (Courtesy of Illinois Agricultural Experiment Station.)

and 1931 (*16*) and in Illinois in 1931 and 1932 (*31*), practically all grass and clover seedings in experimental plots perished from drought, but Korean lespedeza survived. Abundant growth is, however, directly dependent on moisture (fig. 6). In dry seasons, lespedeza may not grow tall enough to be cut for hay except on favored places, whereas in a year of abundant and seasonable rains, it will grow 1 to 2 feet high and produce a heavy crop of hay.

The response to length of day is exhibited in the production of flowers and seed. At East Lansing, Mich., Korean lespedeza began growth early and had a long growing season. The plants grew to more than 18 inches high but did not bloom—the days were too long. At the Arlington Experiment Farm near Washington, D. C., seedings made July 17 produced a full seed crop. Seed production is not dependent on the length of the growing period but on the number of hours of daylight.

ACREAGE OF LESPEDEZA

No satisfactory acreage figures are available though isolated data may give some clue to the extent to which the annual lespedezas are grown. The United States Census for 1935 records the acreage cut for hay from sweetclover and lespedeza. In using these data it is necessary to make an arbitrary distinction between the figures for these two crops in accordance with what is known of their distribution. In the Gulf States it will be safe to assume that the figures refer to lespedeza hay as the amount of sweetclover harvested for hay, if any, is relatively insignificant. In the East North Central and in the West North Central States the bulk of such hay is undoubtedly sweetclover though some lespedeza hay is harvested in Illinois and in Indiana. In Missouri the larger part of the acreage reported is lespedeza. In the South Atlantic States, the greater part of the acreage is lespedeza and the same is true of Arkansas and Louisiana in the West South Central group. The remarks in the last column of table 1 are based on these assumptions, and the acreage figures are taken from the census.

TABLE 1.—*Acreage of lespedeza and sweetclover cut for hay, 1929 and 1934,[1] the percent increase, and the probable proportion of lespedeza*

Division and State	Acreage		Increase	Remarks
	1929	1934		
	Acres	*Acres*	*Percent*	
West North Central: Missouri	32, 016	78, 557	145. 4	Probably all lespedeza.
South Atlantic:				
Virginia	15, 274	64, 519	322. 4	Probably mainly lespedeza.
West Virginia	1, 673	6, 358	280. 0	Probably largely lespedeza.
North Carolina	20, 884	137, 062	556. 3	Probably nearly all lespedeza.
South Carolina	711	4, 127	480. 5	All lespedeza.
Georgia	1, 074	8, 210	664. 4	Do.
East South Central:				
Kentucky	38, 073	455, 139	(2)	Do.
Tennessee	150, 343	752, 425	400. 5	Do.
Alabama	6, 124	30, 957	405. 5	Probably mainly lespedeza.
Mississippi	80, 093	87, 306	9. 0	Do.
West South Central:				
Arkansas	30, 661	33, 145	8. 1	Probably all lespedeza.
Louisiana	24, 062	34, 452	43. 2	Do.

[1] 1935 census.
[2] More than 1,000.

The 5-year period 1929–34 coincides with a period of renewed interest in lespedeza, and, especially in such States as Virginia, North Carolina, Kentucky, Tennessee, and Missouri, the increases shown reflect the spread of Korean lespedeza.

But these figures tell only a part of the story. The Illinois Agricultural Experiment Station (*31*) estimated that, in 1935, 100,000 acres were occupied by lespedeza in that State. Officials of the Kentucky Agricultural Experiment Station have estimated that the acreage in lespedeza in that State increased from about 3 million in 1933 to 5 million in 1938. This was alone or in mixtures and the crop is said to be grown on every farm in the State. In 1937 the Missouri Agricultural Experiment Station (*10*) estimated that Korean lespedeza was being grown on 2 to 3 million acres in that State. This estimate was increased to nearly 6 million acres in 1938.[6] It was estimated (*28*) that 616,919 acres were in lespedeza in North Carolina in 1937. In spite of the inadequacy of the data, therefore, it is evident that the total acreage in lespedeza in the region to which it is adapted is an impressive one.

The crop-reporting board of the Bureau of Agricultural Economics estimated that 2,036,000 acres were cut for hay in 1937, producing 2,107,000 tons or an average of a little more than 1 ton per acre (table 2). Again it is evident that the great increase in acreage has been in the States in which Korean lespedeza is the dominant species. The acreage in pasture and that used only for erosion control or soil improvement is doubtless many times greater than the acreage from which hay was cut. It is known that in 1937 and 1938 there were large increases in the acreage of lespedeza in South Carolina and in Georgia, but figures are not available.

TABLE 2.—*Acreage and production of lespedeza hay, average 1928–32 and annual 1936–37* [1]

State	Acreage harvested			Production		
	1928–32 average	1936	1937	1928–32 average	1936	1937
	1,000 acres	*1,000 acres*	*1,000 acres*	*1,000 tons*	*1,000 tons*	*1,000 tons*
Illinois	---------	16	75	---------	7	75
Missouri	---------	40	140	---------	22	140
Virginia	---------	91	127	---------	64	146
North Carolina	[2] 48	135	138	[2] 45	122	124
South Carolina	---------	10	14	---------	7	11
Georgia	---------	16	16	---------	12	13
Kentucky	128	248	460	139	174	506
Tennessee	198	775	775	191	542	775
Alabama	9	35	30	7	28	24
Mississippi	70	112	112	80	112	129
Arkansas	31	63	113	30	44	124
Louisiana	26	37	36	29	44	40
United States [3]	504	1,578	2,036	516	1,178	2,107

[1] From Crops and Markets (*41, v. 14, p. 272*).
[2] Short-time average.
[3] Additional quantities produced in other States but data insufficient for preparing estimates.

CULTURE

LIME AND FERTILIZERS

While the lespedezas are commonly thought of as plants for acid soils of low productivity, it does not follow that growth will not be improved by using lime and fertilizers. On some fields these soil amendments are essential for any but the most meager growth.

The need for lime and fertilizers depends on the supply of nutrients in the soil. If soils are very poorly supplied with lime or other minerals, these elements must be added to insure a vigorous growth of lespedeza, but lespedeza will do well on soils to which considerable quantities of minerals must be added to secure any growth of clover. Compared with clover, therefore, the lespedezas will do well on acid soils of low productivity. On the other hand, a soil too well supplied with lime, as the black-belt soils of Alabama and Mississippi, may not be suitable for lespedeza. On these soils, lespedeza has been observed to be chlorotic.

---

[6] Information given orally to the author.

The Alabama and Louisiana Agricultural Experiment Stations advise the use of phosphate. Indeed, lespedeza makes but little growth on the sandy soils of the Coastal Plains unless supplied with phosphate. In experiments at Princeton, Ky. (*16*), 1 ton of limestone increased the yield of Korean lespedeza by 595 pounds per acre, superphosphate alone increased the yield by 585 pounds, and 1 ton of limestone plus superphosphate increased the yield by 1,620 pounds per acre. In a series of experiments at Jackson, Tenn. (*6*), carried over 3 years, it was found that the first year (1914) lime increased yields by 63, the second by 30, and the third by 20 percent. Fertilizers showed no effect, but on the unfertilized plots the yield from the limed plots was markedly higher than that from the unlimed plots.

At the Kentucky Agricultural Experiment Station substation at Mayfield, the application of lime and phosphate is said to have doubled yields of lespedeza hay. On soils of naturally low productivity in southern and south-central Illinois, liming was necessary to get any growth whatever (*31*). The Virginia station (*12*) found that lime alone more than doubled the yield of Korean lespedeza and the use of lime, superphosphate, and muriate of potash increased yields from 0.8 ton per acre on an untreated plot to 3.5 tons on the plot receiving lime and fertilizers.

On the other hand, at the Missouri station (*8*), while an application of 200 pounds of 20-percent superphosphate increased yields of Korean lespedeza somewhat over the check plot, the yields on the plot to which 3 tons of lime only had been applied were lower than those from the check plot. This land required from 2½ to 3 tons of lime to neutralize the acidity of the soil. It should be added that several years later Korean lespedeza appears to be showing some effect from the use of lime on these soils (fig. 7). The North Carolina Extension Service (*1*) states that while there is a moderate response to lime, the use of fertilizers on lespedeza is not commonly profitable.

The record of experimental work presented confirms the conclusion that the question of lime and fertilizers is a local one: on some soils they are necessary, on others not. Experience on the rather poor soils commonly encountered on the Soil Conservation Service projects has shown that a better growth with a consequently stronger root system is secured by the use of lime and phosphate. The heavier growth provides better soil protection and more organic matter for these worn soils. It, therefore, usually pays to lime and fertilize these soils. Phosphate proved to be the critical factor on certain poor soils in North Carolina. Here lime and potash produced little response, and potash alone none, but when phosphate was added a luxuriant growth resulted (fig. 8). Whenever lespedeza is seeded on fertilized small grain on fairly good soil or follows a

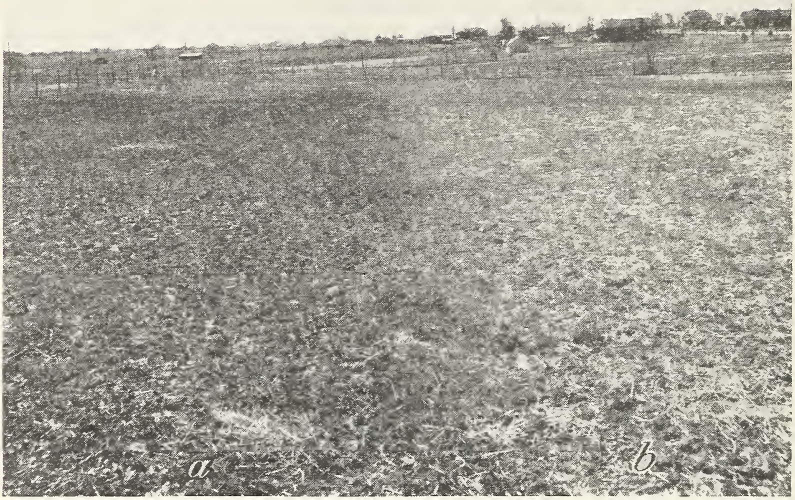

FIGURE 7.—Lime often improves growth. The strip *a* was limed in 1935, and in March 1938 had a good stand of Korean; *b* received no lime and had only a partial stand.

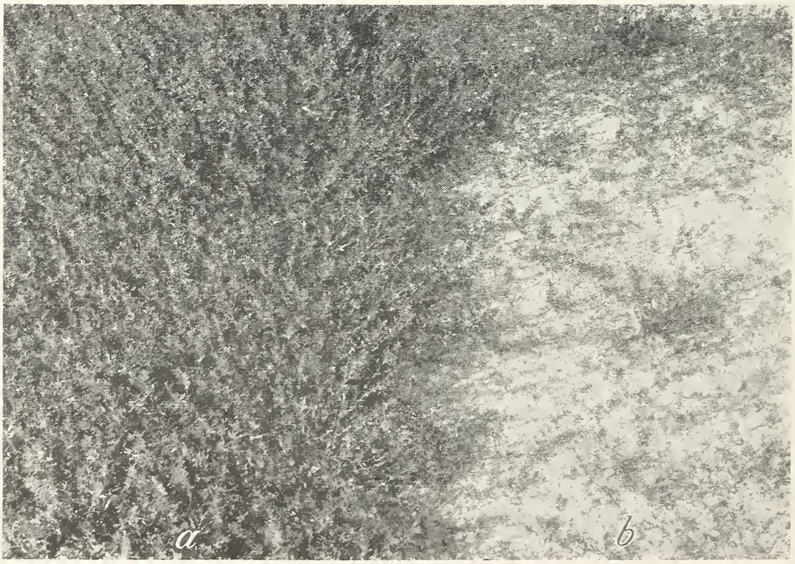

FIGURE 8.—Kobe lespedeza on poor land in North Carolina. The strip *a* was fertilized with potash and phosphate; *b* was not fertilized. The result shown is due to superphosphate as potash and lime were of no value.

well-fertilized cotton crop, the residual fertilizer is often all that is needed.

In connection with lime and fertilizer another condition should be considered. In some sections it is reported that lespedeza no longer makes the vigorous growth it once did but that the application of lime and phosphate improves the growth. This can only mean that the soil supply of these substances has become depleted to a point where even lespedeza no longer thrives.

Many soils in Kentucky, Tennessee, Missouri, and in the Piedmont once produced an abundant growth of red clover. Continued cropping and erosion has lowered the level of fertility of these soils until now lespedeza has largely replaced the older crop. There is real danger, however, that a continuance of this process, the removal of calcium and minerals by cropping and erosion, may further lower the fertility level so that even lespedeza can no longer give the returns it once did. Every ton of hay removes some calcium and phosphorus and when the lespedeza is grazed these elements are removed in the bones of the livestock. Plants, even when they are turned under where they are grown, cannot add minerals to the soil, and it is inevitable that the constant removal of these elements over a term of years will so lower the quantities available for plant growth that declining yields will result. It is the part of wisdom, therefore, to keep up the supply of minerals in the soil even if such applications do not materially increase immediate yields.

EFFECT OF LIME AND FERTILIZERS ON CHEMICAL COMPOSITION

The value of a given feed depends not only on the protein content but on the calcium (lime) and phosphorus content. It is well known that on soils markedly deficient in calcium and phosphorus, the herbage is not rich enough in these elements to insure healthy growth of livestock. Analyses of lespedezas grown on poor land have shown that the herbage is low in calcium and phosphorus. Such hay is of inferior feeding value. In Kentucky (*17, p. 57*) Korean lespedeza grown on good land contained 0.63 percent of phosphoric acid while that grown on an unproductive soil contained 0.23 percent. Some samples contained even less, the average of a number of determinations in Kentucky being 0.17 percent (*18*).

The Tennessee station has recently shown that lespedeza grown on good soil contained more calcium, phosphorus, and nitrogen than that grown on poor soils (*43*).

It has also been shown that the application of lime and phosphate to soils markedly deficient in these nutrients results in a higher calcium and phosphorus content in the herbage. On a light-colored soil of low productivity in Illinois (*15*) the phosphorus and calcium content of lespedeza was increased from 0.369 percent without treatment to 0.421 percent for phosphorus and from 1.04 to 1.196 percent for calcium after treatment with lime and phosphate. In experiments by the Division of Forage Crops and Diseases, Bureau of Plant Industry, at Statesville, N. C., the phosphorus and calcium content of Kobe and Korean lespedeza hay was markedly increased by an application of lime and phosphate to the soil. For the sake of quality, therefore, as well as for the quantity of hay produced, it is desirable to use lime and phosphate.

INOCULATION

The bacteria that produce nodules on lespedeza roots are widely distributed in the southern part of the lespedeza territory, and artificial inoculation is not necessary. In northern Missouri and Illinois, and sometimes in Kentucky, however, the use of artifical inoculation either by culture or soil has been shown to be necessary or advisable.

Many of the failures of Korean lespedeza or the poor growth often reported may doubtless be traced to inadequate nodulation. Some observations indicate that Korean is inoculated with somewhat more difficulty than common lespedeza. It has been thought that Korean required a special strain of the inoculating organism, but this has not been proved. It is not improbable that the greater difficulty with Korean may be associated with the higher lime requirement of this variety. It has been shown by the Illinois Agricultural Experiment Station (*31*) that inoculation increased yields on limed land by 232 percent and on unlimed land by 362 percent. On this acid soil, the percentage of plants with good nodulation increased with the increased application of lime. It has also been observed that Korean lespedeza may increase progressively in stand and growth for 2 or 3 years on the same area. This phenomenon may be best explained by assuming a progressive increase in inoculation.

METHOD OF SEEDING

The annual lespedezas are easy to grow: no special cultural methods are necessary. They may be seeded alone or on grain and under favorable conditions even in corn at the last working. A firm seedbed is necessary and this is assured wherever lespedeza is seeded on winter grain. Before lespedeza is seeded with oats the seedbed should be well rolled; a cultipacker is a good tool for this purpose. Seeding lespedeza alone on ground that had a well-cultivated crop the previous season is also a good practice. If lespedeza is seeded alone on weedy land it is likely to be smothered, as its early growth is slow. When cotton or corn land is put into lespedeza, it is only necessary to disk or harrow the land to establish a firm, smooth surface.

Seeding may also be done on an established pasture, but care must be taken that the seed reaches the soil. A light disking or a working with a spike-tooth harrow will expose sufficient soil so that the lespedeza will take hold. Seeding may be done by hand or the seed may be distributed through a cyclone-type, a wheelbarrow seeder, or by the grass-clover attachment on a grain drill. When lespedeza is seeded with a drill, care must be taken not to put the seed down too deep. A half inch is about right. Seeded broadcast, the seed may be left on the surface, especially if it is slightly rough. When lespedeza is seeded on grain it is well to run a harrow over the surface so that the seed may not wash down and collect in groups after a heavy rain. Harrowing is especially important where there is an appreciable slope to the land and should be done on the contour. Korean lespedeza may also be seeded just before the last working of corn, provided this is not later than early July. The corn should be cultivated as level as possible. Under favorable moisture conditions a good growth will result, which may be used for late grazing or for soil protection. Enough seed may also be produced to provide a volunteer crop the next year.

TIME TO SEED

Seeding is done in early spring, the time varying from south to north. Farther south seeding is commonly done during the last half of February and early March. Farther north dates range from early March to early April. Seeding on grain can be done earlier than seeding on bare ground. A very early seeding is subject to late freezes following warm days during which seed may sprout. The Missouri station (*8*) records that Korean lespedeza seedlings are more resistant to late freezes than red clover or alfalfa seedlings. In experimental work at Nebraska University (*38*) it was shown that Korean lespedeza was less cold-resistant than common lespedeza or than red clover and alfalfa. Lespedeza was most cold-resistant in the cotyledon stage, the resistance decreasing later. In red clover and alfalfa the cold resistance increased with age.

Observations on volunteer stands in North Carolina have shown that the early seedlings may be killed by freezing but that in a volunteer seeding sufficient hard seed remains to ensure a stand even after two good stands have been killed. In a volunteer seeding there is, of course, more seed on the ground than would be the case with a first-year seeding. There is some danger that a too early seeding may be damaged. As a rule sowing about 2 weeks before the last freezes are expected in any locality is not far from right. No great advantage is derived from very early seeding as the plants do not grow rapidly until warm weather. Late-fall or winter seeding cannot be recommended as warm days may start a growth that will later be killed.

RATE OF SEEDING

The amount of seed to sow will depend on the purpose for which the crop is wanted. If hay is to be cut, the seeding should be generous—about 25 pounds per acre for Korean, 25 to 30 for common and Tennessee 76, and 30 to 40 for Kobe. Since a pound of Korean lespedeza seed contains 240,000 seeds, a seeding of 1 pound per acre would place approximately 5.5 seeds on every square foot. Theoretically, therefore, 5 to 10 pounds should give a full stand, but experience has shown that a better stand is secured and more hay harvested when a heavier seeding is made. In Illinois (*31*) in 1933 a 20-pound seeding rate of Korean produced more hay than a 10-pound rate, but with a 40-pound seeding rate the hay yield declined. On the other hand, the Kansas station recommends seeding 10 to 12 pounds of Korean and the Missouri station suggests 10 to 15 pounds (*8*). Much will obviously depend on the preparation of the seedbed. On a well-prepared seedbed a saving can be made in the quantity of seed while if the seedbed cannot be so well prepared more seed must be used to allow for the usual hazards to the young plants.

If a seeding is made to secure a volunteer stand the following season, the seeding rate may be cut to 3 to 8 pounds. This lighter seeding may produce plants enough to provide some grazing and will seed the ground for the volunteer crop. In mixtures or for seeding on established worn pastures a lighter seeding is also used. The

Kansas station advises 2 to 4 pounds of Korean on pastures, the Kentucky station 6 to 8 pounds. The Louisiana station suggests 15 to 20 pounds of common for improving old pastures; the Missouri station, 3 to 10 pounds of Korean on pastures or meadows. If lespedeza is included in pasture mixtures the rate should not exceed 5 pounds, as a too heavy stand can readily smother out much of the young grass the first season. On poor soils or critical slopes or in meadow outlets, where a dense growth is wanted as quickly as possible, a heavier seeding, up to 30 to 40 pounds per acre, of common or Korean may be justified.

GERMINATION

While the germination of new-crop lespedeza seed is usually satisfactory, it is often not high, as determined by a germination test. Extensive records kept by the Missouri University seed laboratory and by the United States Department of Agriculture show a dominant range of germination of from 70 to 85 percent, with an occasional sample showing 90 percent or more. When the tests are made within 60 days of harvest many hard seeds are present and the sum of germinated and of hard seed is usually 90 percent or more. These hard seeds gradually change, and tests made later in the season commonly show a higher percentage of germination and a lower percentage of hard seeds; the sum of the two, however, is virtually the same as in the earlier tests.

Middleton (*20*) at the North Carolina Agricultural Experiment Station has reported on a series of tests of Korean lespedeza seed as shown in table 3.

TABLE 3.—*Percentage of germination and of hard seed of Korean lespedeza seed at the North Carolina Experiment Station, 1932*

Month	Germination	Hard seed	Total viable
	Percent	*Percent*	*Percent*
November	46.70	47.25	93.95
January	83.30	12.25	95.55
March	84.85	11.05	95.90

It has been said that lespedeza seed loses its vitality so rapidly that the use of 2-year-old seed is questionable and that 3-year-old seed is useless. This is certainly not true of seed properly stored. The Louisiana station (*5*) has reported that common lespedeza seed tested at that station showed such a loss of vitality the second and third years as to be practically worthless, and Essary (*6*) in Tennessee confirmed this conclusion. However, a lot of common lespedeza seed kept at the Department of Agriculture out of the crop of 1928 was tested in December 1930 and in November 1931. The germination of the 2-year-old seed was 70.5 percent plus 18.5 percent of hard seed and of the 3-year-old seed was 63.75 percent with 20.75 percent of hard seed. Korean lespedeza appears to retain its vitality longer than common or Kobe. One lot harvested in 1922 showed a germination of 66 percent and 29 percent of hard seed in April 1927.

In some unpublished work done at the seed laboratory of the Department it was found that the germination of Korean, Kobe, and common lespedeza seed was low in October and November of the harvest year, 1931, but rose rapidly in January 1932. The same samples were tested at intervals in 1932 and 1933 and showed no decline in germination through May 1933. The Kentucky Agricultural Experiment Station (*18*) found that Korean lespedeza seed showed very little loss of vitality when kept in the laboratory for 33 months but seed kept in a basement for the same period suffered a material decline in vitality.

If properly stored, lespedeza seed may be kept safely for a year or two. Seed stored in a damp, warm environment will lose vitality more quickly than that kept in a dry environment. This would seem to be the explanation of the differences in results reported. The safest procedure is to test the seed during the winter before sowing. Seed showing a germination of 70 to 90 percent with most of the remaining seeds hard should give a satisfactory stand if seeded at the regular rates.

THE LESPEDEZAS FOR GRAZING

Lespedeza is probably the most widely useful and productive leguminous grazing crop in the South (fig. 9). The annual lespedezas are primarily pasture plants. For summer grazing, lespedeza is one of the most important pasture plants in the southeastern quarter of the United States. It is also found in hill pastures of southern Ohio, Illinois, and Indiana and is of great value throughout Missouri. The common lespedeza is largely found in association with grasses while the improved varieties are more often used in pure stands. When used as pasturage, lespedeza best fills the dual role of forage and soil-conserving plant.

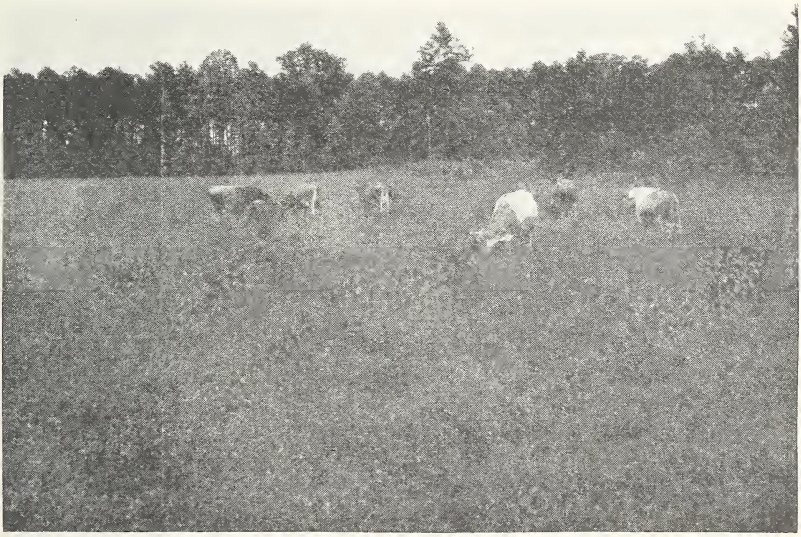

FIGURE 9.—Dairy cows on lespedeza pasture in North Carolina.

In the Gulf States common lespedeza is mainly grown with Bermuda grass and sometimes with carpet grass and Dallis grass, though carpet grass that makes a dense growth tends to crowd it out. An application of phosphate fertilizer to carpet-grass pastures will give the lespedeza renewed vigor. On the upland soils of the Coastal Plain, lespedeza suffers from drought and from lack of phosphate, but wherever moisture and fertility conditions are favorable it makes abundant summer pasture. As a rule, it is of little importance in the native unimproved pasture but is a valuable constituent of all improved pastures. The grasses with which it is associated in the South are summer-growing grasses. Farther north it fits in well with redtop and orchard grass and sometimes even Kentucky bluegrass. The grasses furnish early and late grazing, and the lespedeza provides grazing during midsummer when the grasses are poor or dormant. Further, a pasture composed of grasses only soon becomes unproductive unless on very fertile soil, and the lespedeza at least helps to keep up the nitrogen supply.

CARRYING CAPACITY

The carrying capacity of a good stand of lespedeza is high. The actual number of livestock that can be grazed will naturally depend on various factors, especially the season. A volunteer stand will generally carry more than a first year's stand, but even when a stand is rather thin lespedeza will carry many more cattle during July, August, and September than an equal area of good bluegrass. Permanent pastures in the South have been improved as much as 25 to 100 percent by the addition of lespedeza, and the carrying capacity of a pure stand under good moisture and soil conditions and for a limited time is often phenomenal. One farmer reported having kept 10 dairy cows on 1 acre during the latter part of July and all of August.

In the South a stand of common lespedeza after oats or rye may be expected to yield 100 days' grazing per acre and a volunteer stand will carry 1 animal unit per acre for the season. The Kentucky station (*16*) has estimated that on soils of medium fertility 1,000 pounds of live weight can be grazed per acre from June to October, while fertile fields will carry two and three times that amount of stock in good seasons. Nor does this heavy grazing prevent the formation of enough seed to ensure a volunteer crop. The Missouri station (*8*) studied the carrying capacity of Korean on land of medium fertility. In 1928 three 2-year-old heifers each weighing about 800 pounds were carried on three-fourths of an acre. "They gained a total of 240 pounds over a period of 122 cattle days." In spite of the heavy grazing the lespedeza reseeded and the volunteer stand was again grazed. In 1935 a 10-acre field of volunteer Korean in Missouri (*9*) carried 30 young cattle from July 23 to September 17, providing 168 pasture-days per acre. The gain per acre in live weight was 181.9 pounds.

At the Sni-A-Bar farm in Missouri (*8*) 12 yearling heifers grazed on 10 acres of Korean lespedeza from July 15 to September 2 and gained 1.2 pounds per head daily over a period of 7 weeks. A seed crop of 400 pounds per acre was taken from this field in October.

On a poor soil in the Ozarks, Korean made little growth the first year, was better the second year, and in the third year made a good stand. The lespedeza was grazed each year and during the last season when the stand was mainly Korean with a little redtop, the field of 11 acres was grazed with 10 mature cattle from May 15 to September 1 and with 17 from September 1 to October 3, a total of 148 pasture-days per acre. During that time the ground was always covered and adequately protected. On this extremely poor soil no other plant would have given as much grazing and plant cover during that period.

In a study made by the Department of Agriculture (*21*) it was found that the average carrying capacity of lespedeza was about 1.1 animal units per acre, though this did not represent the full capacity of the field as in some cases the cattle had been removed early in September in order that a seed crop might be taken. A Kentucky farmer carried 60 cattle and 100 ewes with lambs on 30 acres of Korean from June 10 to September 10, when he took them off to get a seed crop. Cases of great carrying capacity for short periods in midsummer could be cited. Even in the dry year of 1930 in Kentucky Korean lespedeza often carried 1 animal unit per acre from late May to frost. Advantage may be taken of this ability of lespedeza to carry a heavy load during summer to shift cattle from bluegrass to lespedeza and thus save the bluegrass from damage.

The experiences referred to cover the use of a pure stand of lespedeza, chiefly Korean. Kobe has probably fully as high a carrying capacity and may be grazed later in the season. When lespedeza is but one constituent of a permanent pasture, an accurate estimate of its carrying capacity is not possible, but it is generally agreed that it materially increases the value of such a pasture.

TIME TO GRAZE

Since lespedeza is a hot-weather crop—starting late and growing slowly at first— it is not a plant for early grazing. It makes up for this, however, in midsummer when grass is poor. How soon a lespedeza field can be grazed will depend on variety, management, and locality. A volunteer crop of all varieties is ready to graze earlier than a new seeding on grain. Korean may be grazed about 2 weeks earlier than the other varieties. At lower altitudes grazing will begin earlier than at higher altitudes and on fertile soil earlier than on poor or droughty soil.

In southern Alabama common lespedeza is reported as ready to graze in early April. In southern North Carolina Korean is sometimes ready to graze in early May; the common about June 1. In the western part of Kentucky Korean may be grazed about the middle of May; in the eastern part early in June. In Missouri June 1 to 15 is the usual date, while in Illinois Korean does not reach sufficient height before July 1. The main part of the grazing season is July, August, and September, with some in October or even later depending on frost. Except in the northern part of its range Korean lespedeza will ripen and cease growth before frost while the varieties of the striata group will continue growth until frost.

PERMANENT PASTURE

Lespedeza should be a constituent of all permanent pastures in the South. Common lespedeza is more generally used than the other varieties except in the northern and western parts of the lespedeza territory where Korean is used. Common lespedeza often shows greater ability to persist in competition with grasses than Korean. Even as far north as Beltsville, Md., common lespedeza seeded in unfertilized mixed-grass pasture has maintained itself for 6 years while Korean has practically disappeared. In heavily fertilized pasture neither variety has been able to maintain itself. The continued existence of Korean lespedeza that is seeded with Kentucky bluegrass appears to depend on the thickness of the bluegrass sod. Under conditions favorable to bluegrass, the bluegrass tends to crowd out the lespedeza, and in fact any other legume. Close grazing during May will assist the lespedeza by keeping the bluegrass down until the lespedeza is established. Here grazing management is important.

In Kansas and in some other sections Korean is said to have maintained itself in a bluegrass sod, but usually it occupies the bare spots nearly always found in any but the best sod. Korean lespedeza fits in especially well with a bunch grass like orchard grass. The vacant spaces nearly always found in a stand of orchard grass provide plenty of free space for the lespedeza. The two plants do not crowd each other, but one supplements the other; the grass provides early and late grazing while the lespedeza fills the gap from early June till frost. On the Kentucky station a pasture of orchard grass and Korean lespedeza is said to have kept in productive condition for 12 years and in 1937 was as good as ever (*18*).

Redtop and bluegrass should be seeded in fall, lespedeza in spring. Not more than 4 to 5 pounds of Korean lespedeza should be used when laying down such a pasture on poor land as a heavier seeding is quite certain to damage the young grass the first summer. For renovating established but worn pastures, the surface should be scratched and the lespedeza seeded at a rate of 10 to 15 pounds per acre. The addition of phosphate will help both the grass and the lespedeza.

ROTATION PASTURE

A great deal of lespedeza is seeded on fields included in a regular rotation, and the lespedeza is grazed for 1 or more years before being plowed. Perhaps the most striking of these rotations is the annual rotation of grain and lespedeza. Either fall- or spring-seeded grain may be used depending on the way these grains succeed in any locality. Though this rotation is practiced in other States, it has been most extensively used in Tennessee (*37*) and Missouri (*9*), and the methods advocated there are set forth in this discussion.

LESPEDEZA WITH SMALL GRAIN

Korean lespedeza in combination with wheat, winter barley, or rye is seeded on the grain in the spring and is ready to graze soon after the grain is harvested. If the season is good the grain may be allowed to ripen; if dry, it is better to cut the grain for hay. The lespedeza may then be grazed until fall, and after most of the seed has ripened the field may be well disked and grain seeded again. The following spring a heavy volunteer growth of lespedeza that can be grazed during the summer will result. By this system two crops are produced annually on the same land with a resultant decrease in the unit cost of production. The soil is covered at all times; even in fall when the lespedeza is disked there is some debris, and the winter grain soon protects the soil from late rains. For this rotation a variety of lespedeza must be selected that will mature seed by the time fall grain must be sown. For this the Korean seems best adapted, though in the Gulf States the common and Kobe may be used.

Grazing the lespedeza fits into this plan better than allowing the seed crop to ripen. If the lespedeza is grazed, enough seed will mature for reseeding before wheat is sown while a full seed crop might not ripen early enough. The Missouri station (*11*) reports that on various experiment fields wheat after lespedeza has not failed for 15 years.

The cattle droppings during grazing and the addition of the usual amounts of phosphate fertilizer to the wheat also keep up the productivity of the soil so that yields of wheat and lespedeza increase from year to year. The grain also helps to suppress early weeds. Such a system requires prompt work in the fall to get the wheat in the ground in time. The lespedeza should be grazed down or cut close, as a heavy stand of lespedeza will be difficult or impossible to handle by disking. The disk must be sharp and, if the soil is dry, may need to be weighted. In such a rotation, barley cannot be fall-grazed as it cannot be planted early enough. Some spring grazing can be had without seriously reducing the yield of grain.

If spring oats are used, the old lespedeza stand should be disked in the spring. In that case, even the later varieties of lespedeza may be expected to produce a seed crop. Naturally, the oats must be seeded as early as possible. This early soil preparation will not destroy the lespedeza. Even if some seedlings are killed, there will be plenty of seed left to produce a stand. The oats serve to suppress weeds that might seriously damage the lespedeza. The Missouri station reports that under this system enough hard lespedeza seed accumulates in the soil to ensure a stand even when an early frost seriously damages the crop in any year.

For the lespedeza-spring oats rotation an early maturing variety of oats should be selected. A late variety may offer too great competition for moisture late in the season. Lespedeza may be seeded in a winter grain 1 year and the sod spring-disked for oats the following year. Many variations of this general plan will suggest themselves, based on the variety of grain and of lespedeza suitable to any section. All such rotations will meet the need of a continuous ground cover for soil protection.

Reference was made to the harvesting of the grain in this rotation, but the grain may also be pastured. The procedure will vary with the crop. Barley can make a good fall pasture, but for this purpose it must be seeded too early for the lespedeza to ripen. Rye should usually be pastured in spring, and wheat and oats may be pastured if desired. They make excellent spring grazing, rye especially so on lands of low productivity, and if Korean lespedeza is used it will be large enough to graze as the grain is eaten. Such a combination is suggested for worn soil that is to be retired to pasture. A permanent grass sod would be desirable on such land, but the soil is often too poor to support a perennial grass. Grass seedings made in fall on severely eroded land have done well in early spring, but under the combined effect of heat, drought, and the competition of lespedeza, the grass has usually died in summer. If the grass dies, the lespedeza, after it matures, may be disked on the contour, and rye may be drilled to serve as winter protection and fall and early spring grazing. Lespedeza will follow in the summer. If 150 to 200 pounds of phosphate are used on the grain the growth of both the grain and lespedeza will be stimulated. The combination will make a better cover than a poor sod of perennial grass. Observation indicates that under such treatment the soil is gradually built up to a point where it will support a grass sod.

LESPEDEZA IN LEGUME MIXTURES

Korean lespedeza may also be seeded with red clover or sweetclover. With red clover the lespedeza serves as insurance against legume failure. During the seeding year it will grow with the clover. In the second season if the clover is good there will be little lespedeza since the early growing clover will smother it, but if the red clover is killed by disease or by heaving, a volunteer crop of lespedeza will develop and the rotation will not be broken. Korean lespedeza may be seeded on grain when sweetclover is seeded and can be grazed with the sweetclover after grain harvest. The second season the sweetclover starts early and must be heavily grazed if there is to be any lespedeza. When the sweetclover is kept down by grazing the lespedeza will come on and furnish grazing late in the season after the sweetclover is consumed.

KOREAN LESPEDEZA IN AN ALL-YEAR PASTURE SYSTEM

The vigorous growth and high carrying capacity of Korean lespedeza, where it is adapted, makes it an ideal summer-pasture plant. Advantage has been taken of this fact by the Missouri Agricultural Experiment Station (*10*) to develop a pasture system based on Kentucky bluegrass for spring and Korean lespedeza for summer, supplemented by grain pasture during fall and early spring. This system provides for the maximum use of bluegrass during the period of its greatest growth and value. During summer when the grass is dormant and would be damaged by grazing, the cattle are turned on a field of pure Korean lespedeza. On this the cattle gains made on the flush bluegrass pasture are maintained and even increased. Grain pasture and the use of the fall bluegrass growth in winter makes for nearly continuous grazing. Korean lespedeza here occupies the key position for maintaining production during the hot season when production of milk and beef usually decline.

The number of acres of lespedeza that must be provided for the cattle from a given area of bluegrass will depend on conditions. If both bluegrass and lespedeza are good, the lespedeza may be expected to carry, for the summer months, double the number of cattle bluegrass will carry. On highly productive land for both bluegrass and lespedeza, the latter will carry during the summer "three or four times the amount of stock that could be carried during that same period on permanent pasture grazed from the first of May up to the summer period."[7] While lespedeza will always occupy a large place in permanent pasture mixtures, the development of the Missouri system raises the question of whether in many cases it may not be wiser to have grass on one field and lespedeza on another. More lespedeza can certainly be grown per acre alone than in a grass pasture, and the complete resting of the grass will restore its productive capacity. The grass is damaged much more by grazing and trampling during the hot months than it is in spring. A worn grass pasture becomes subject to erosion, which when started on slopes may lead to gullying. Keeping up the vigor of the grass by removing cattle during midsummer will help to prevent erosion. It may also be pointed out that under this system a grain crop may be seeded in the lespedeza sod each year, so that the land need not be laid aside solely for grazing, but may produce a cash crop as well.

WINTER GRAZING

Korean lespedeza can be used for winter grazing since the leaves do not readily fall with frost. A field that for any reason has not been utilized may afford excellent grazing for at least the early part of the winter. Such a stand will be full of seed, which will raise the protein content of the forage. In Virginia a field of Korean was being grazed in January and samples were taken. Analysis showed 12.85 percent of protein; the stems and leaves contained 5.64 percent and the seeds 37.59 percent. Such dead Korean lespedeza has been said to make good winter grazing in various places. It is said to be better to cut the ripe lespedeza and leave it in small windrows. There is less loss of leaves by this method.

LESPEDEZA FOR HAY

Well-made lespedeza hay is of excellent quality, carrying 55 to 60 percent of leaves by weight. There is less waste in feeding good lespedeza hay than there is in crops with coarse stems, which are refused by stock (fig. 10).

WHERE HAY IS PRODUCED

In the Gulf States hay is made from the common lespedeza. It is too often cut at or near maturity. This makes a poorer grade of hay but has the advantage that by using a seed pan (see fig. 18, p. 38) a seed crop can be harvested at the same time. A better grade of common lespedeza hay is cut in western Kentucky and in Tennessee and North Carolina. In Kentucky, Tennessee, and North Carolina, Kobe is frequently used, and this variety is also becoming popular in northern Alabama, Georgia, and South Carolina (fig. 11). Korean is used in middle and eastern Tennessee, North Carolina, Virginia, Kentucky, Missouri, and Illinois. In these States it forms the bulk

---

[7] C. A. Helm. Letter to author, Columbia, Mo., February 3, 1938.

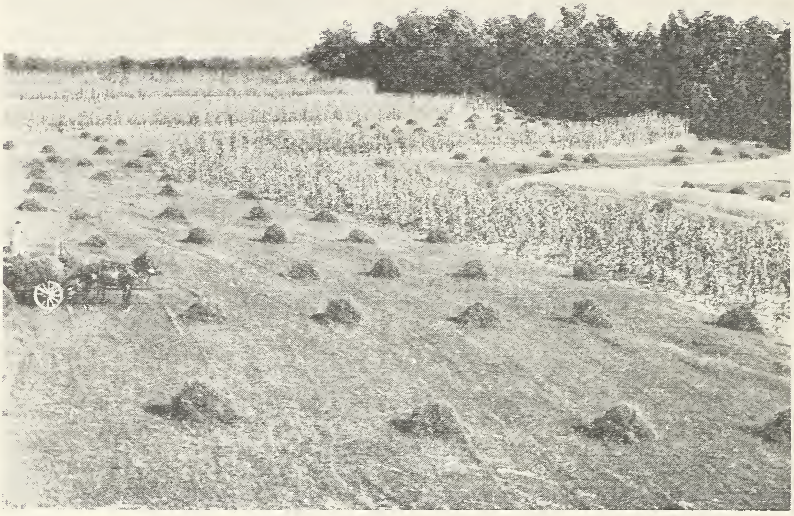

FIGURE 10.—Harvesting hay from a strip crop in North Carolina.

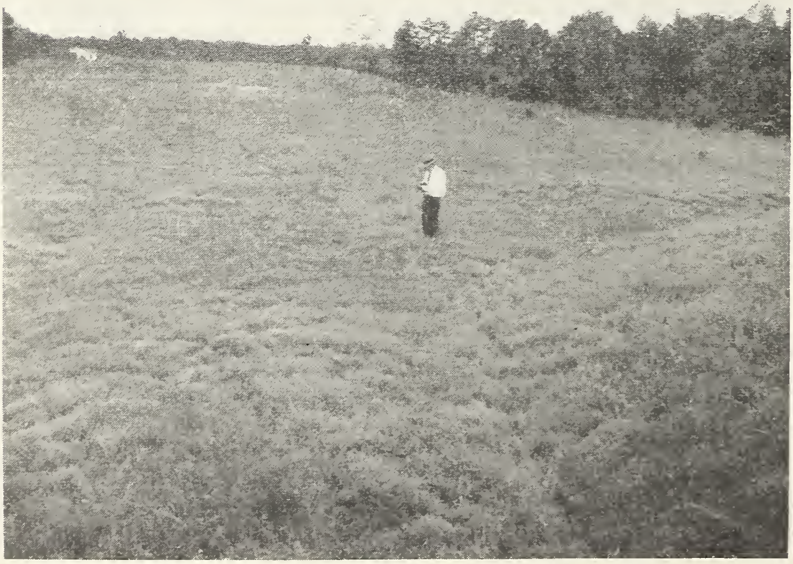

FIGURE 11.—A field of second-year volunteer Kobe lespedeza in North Carolina.

of the lespedeza hay except for Tennessee, where a great deal of Tennessee 76 is grown. Tennessee 76 is also popular in parts of North Carolina.

TIME TO CUT LESPEDEZA HAY

The best time to harvest lespedeza varies with the location and variety. It is generally agreed that the best hay is made when plants are cut in the full-bloom stage, and the date of this will vary. Korean should be cut earlier than the other varieties since it makes a more rapid early growth. If left until the other varieties are ready the yield of Korean will be less and the hay inferior. In North Carolina, Tennessee, Kentucky, and Missouri, Korean will usually be in bloom about the first to the middle of August, and in Illinois, about the end of August or early September. The varieties of the striata group can be cut later both because they continue growth even after seed is formed and because seed setting takes place much later than in Korean.

It is possible, under favorable conditions, to cut hay and get a seed crop the same season. This practice is not general, but it has been done. The result depends on the weather after the hay is cut. If the plants have been cut very low and the weather turns dry there will be no aftergrowth. A stand of Kobe in western Tennessee, however, made more seed from the second growth after hay was cut in early August than was made by a similar area from which no hay had been taken. From Virginia to Missouri the best practice is to cut Korean between July 1 and 15, and Kobe early in August (fig. 12). By this time 8 to 10 inches of growth will have been made. The mower should be set to cut about 3 inches high. Under these conditions a ton or more of excellent hay per acre is secured and new growth develops rapidly. This may be left for seed or a second cutting of hay may be taken. At the western Kentucky substation at Mayfield two cuttings of Korean are regularly taken. The third growth is left to reseed the field, or it too may be removed for hay. A volunteer seeding can usually be assured if the plants are cut high enough to leave some lower branches uncut.

A very rank thick stand may not recover after being cut for hay, especially if cutting is delayed until the crop lodges. In western Tennessee where heavy stands of Tennessee 76 are harvested one or two teeth are sometimes removed from the mower. This leaves a narrow strip of uncut plants every swath width, and these plants reseed the field.

If other conditions such as moisture and soil productivity are good, a satisfactory yield of hay may be expected from first-year seeding, provided plenty of seed has been used. If the first year's stand is a bit thin the second or volunteer stand will give more and better hay. In some sections, especially toward the northern part of the lespedeza territory, a first year's stand may not be well inoculated. In such a case the second year's stand is better and sometimes a full stand and maximum growth is not attained until the third year. For making the best hay, attention must be paid to the clipping of weeds. These may need to be clipped once or twice depending on conditions. A heavy weed content makes for low-grade hay.

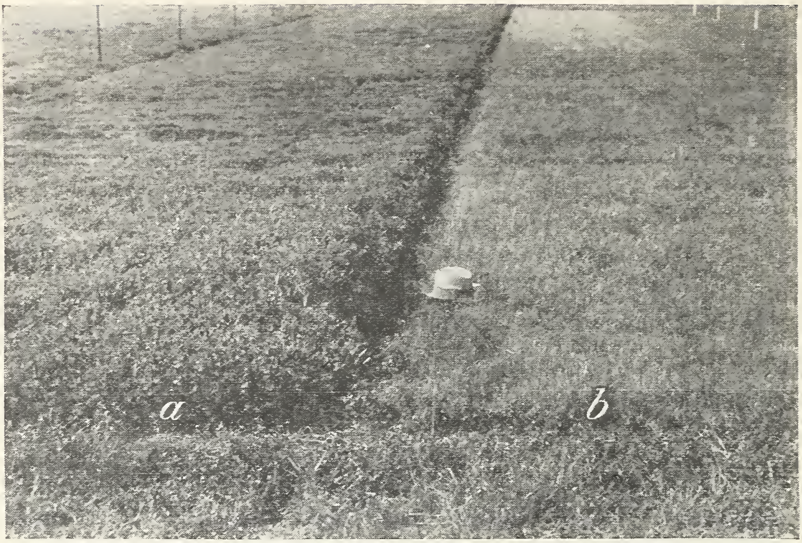

FIGURE 12.—Korean lespedeza at Columbia, Mo. The stand at *a* was cut about the middle of July, that at *b* was not cut till August. (Courtesy of Missouri Agricultural Experiment Station.)

CURING

Lespedeza cures more rapidly than other legumes though the rate of curing will depend on weather conditions and thickness of stand. During good curing weather, if the stand is not too heavy, lespedeza may be hauled to the barn the same day it is cut. As a rule, however, it is better to wait until the next day. The cut material should be raked into windrows 2 to 4 hours after cutting—lying in the swath too long results in bleaching and in the loss of leaves. Many growers bale or haul to the barn from the windrow, but some claim that better hay is made if the material is allowed to cure in the cock. A small loose bale is safer than a large tight one as moisture is not so likely to cause mold.

FEEDING RESULTS

Relatively few definite experiments with feeding hay have been recorded but those that have been made show that lespedeza hay ranks high. At the Mississippi Agricultural Experiment Station (*19*) a hay-feeding trial with mules was made. Only good-quality hay was used, and the grain and concentrate feed was the same for all. The relative values of the hays were expressed as cost per pound of gain, using the current market price of each hay. The lespedeza and the alfalfa hay cost the same per ton. The cost per pound of gain with Johnson grass hay was 36 cents; with timothy, 48; with Bermuda grass, 37; with common lespedeza, 27; and with alfalfa, 21. The lespedeza hay was a little less efficient than the alfalfa but much more so than the grass hays.

At three North Carolina substations (*13*) a trial was conducted in which hay from Tennessee 76 was compared with alfalfa. The alfalfa was found to be 4.86 percent more efficient than lespedeza for milk production. At the Arkansas station (*2, p. 60*) Korean lespedeza was found to be practically equal to alfalfa for milk production.

The Virginia station (*14*) compared Korean lespedeza with alfalfa for milk production in 1935 and 1936. In 1936, when good lespedeza and good alfalfa hay were fed, cows gave 82 pounds of 4-percent milk on lespedeza for every 100 pounds on alfalfa. The cows on lespedeza gained in weight somewhat more than did those on alfalfa. At the Illinois station (*26*) Nevens compared Korean lespedeza straw with soybean hay for dairy cattle and found that the daily milk yield on lespedeza straw was 33.5 pounds while that on soybean hay was 35.5. Slightly more soybean hay was consumed than lespedeza straw. The daily gain of the cattle in weight was greater on the lespedeza straw. The lespedeza straw had been threshed and baled without having been exposed to rain and contained 65 percent of leaves. Later the same worker (*27*) studied the feeding value for dairy cows of extra good Korean and extra good alfalfa hay, both fed with equal quantities of silage and grain. The lespedeza contained 12.7, the alfalfa 16.1 percent of protein. Exactly the same amounts of both hays were eaten and milk production was slightly higher on lespedeza than on alfalfa.

At the same station (*35*) in a trial with fattening steers, it was found that "Korean lespedeza proved superior to alfalfa and soybean hay with respect to rate of gain, cost of gain, dressing percentage, and quality of meat."

The Mississippi station (*23*) reported in 1925 that there was very little difference in the feed value of lespedeza, soybeans, and alfalfa when all were cut at the right stage and properly cured, but in a report on a feeding experiment the next year (*24*) it was shown that soybean hay gave somewhat better results than lespedeza or alfalfa and that alfalfa was a little better than lespedeza.

The experimental data indicate, therefore, that alfalfa is probably a little better feed for dairy cattle but perhaps not for beef cattle. When it is borne in mind that the lespedeza was grown on land that would not produce alfalfa the results of the feeding trials are remarkably good. Lespedeza will, on poor soil, produce a hay almost if not quite as good as any the market affords. Every farmer in the southeastern United States can produce good lespedeza hay while only a few have soil fit for alfalfa.

CHEMICAL ANALYSIS

While chemical analysis shows the percentage of digestible protein to be a little lower than in alfalfa, first-year sweetclover, cowpeas, and soybeans, the digestible carbohydrate equivalent is higher in annual lespedeza than in any of these crops. In various analyses of lespedeza hay made by the Department the percentage of protein ranged from 9.31 to 17.19 percent, the latter being from a fertilized field at Statesville, N. C. A sample of Korean lespedeza hay produced on fertile soil in Kentucky had 17 percent of protein.

The chemical analysis of any herbage plant varies with the conditions under which it was grown and with those under which the hay was cured. Average analyses of all lots reported are, therefore, not to be taken as an indication of the value of a given sample. The average analysis is, however, probably a safer guide in a comparison of different crops than analyses selected to sustain a given point of view. Morrison (*25*) has brought together all analyses of crops and the average figures given may be used to compare one crop with another. For convenience in comparison a few selected figures taken from Morrison have been brought together in table 4. It will be noted that although lespedeza hay falls below alfalfa in digestible protein it contains more total digestible nutrients and less fiber.

TABLE 4.—*Percentage of digestible protein, total digestible nutrients, and fiber in various hays*[1]

Hay	Digestible protein	Total digestible nutrients	Fiber	Hay	Digestible protein	Total digestible nutrients	Fiber
	Percent	*Percent*	*Percent*		*Percent*	*Percent*	*Percent*
Alfalfa	10.6	50.3	29.0	Soybeans	11.1	50.6	28.4
Red Clover	7.0	51.9	27.3	Bermuda grass	3.7	43.0	25.6
Annual lespedeza	9.2	52.2	26.2	Timothy	2.9	46.9	30.1
Cowpeas	12.6	49.4	23.3				

[1] Average analyses from Morrison (*25*).

Besides protein and other digestible nutrients certain minerals, particularly calcium and phosphorus, are important in animal nutrition. Lespedeza is somewhat less well supplied with these minerals than other legumes, but this may be due in part to the fact that lespedeza is commonly grown on soils of lower fertility than those on which alfalfa and the clovers are grown. It has been shown (p. 13) that the addition of lime and phosphate to soils deficient in these minerals had a marked effect in raising the percentage of calcium and phosphorus in the herbage. The calcium and phosphorus content of a few standard hays as reported by Morrison (*25*) are shown in table 5.

TABLE 5.—*Calcium and phosphorus content of certain hays*[1]

Hay	Calcium	Phosphorus	Hay	Calcium	Phosphorus
	Percent	*Percent*		*Percent*	*Percent*
Alfalfa	1.43	0.21	Cowpeas	1.13	0.25
Sweetclover (first year)	1.47	.22	Soybeans	.96	.25
Red clover	1.21	.18	Bermuda grass	.48	.20
Lespedeza	.99	.19	Timothy	.27	.16

[1] From Morrison (*25*).

Analyses by various State agricultural experiment stations show that considerably higher percentages of calcium and phosphorus may occur than the averages given above. The Missouri station (*9*) found 0.35 percent of phosphorus and 1.23 of calcium. In Illinois (*15*) Korean on fertilized land contained 0.421 percent of phosphorus and 1.196 of calcium, and Korean grown on fertile soil in Kentucky (*17*) contained 0.63 percent of phosphorus.

Lespedezas contain more dry matter than other common crop legumes. Stitt (*36*) showed that when cut at the full-bloom stage, common and Tennessee 76 contained 36 to 38 percent of dry matter, respectively, Kobe 43, Korean 37 to 49, alfalfa, first three cuttings, 27 to 29, and Laredo soybeans 28 to 30 percent. Because of this relatively low water content the lespedezas cure more quickly than other leguminous hays.

YIELDS

As with other crops the yields of lespedeza hay vary widely with conditions and the taking of plot yields has little value except to show the yields secured under the conditions of the experiment. It is well known that the yield of hay is primarily affected by moisture conditions. The productivity of the soil will, of course, have an effect, but the yield will be larger on a rather poor soil when there is plenty of moisture than on a fertile soil under drought conditions.

The general crop report for December 1937 (*41, v. 14*), gives the acreage and production of lespedeza hay for 1936 and 1937 in 12 States (table 2). The average acre yield in 1936, a dry year, was 0.75 ton while in 1937 the average yield was 1.03 tons. The figures in the United States Census for 1935 include sweetclover and lespedeza in one table, but if the States in which it is known that little if any sweetclover is produced are selected and the average yields calculated it is found that these agree fairly well with those quoted above. From the census data it may be concluded that the average yield for 1929 was 1.06 tons per acre and in 1934, 0.91 ton.

The average yield of lespedeza hay may then be put at about 1 ton per acre. Of course, such an average yield shows that many acres yielded more than 1 ton. Yield records taken at experiment stations show yields ranging from a little more than ½ to nearly 4 tons per acre. The yield of lespedeza hay is surprisingly heavy. The close leafy stand makes for relatively greater yields than the more open stand of clover or soybeans even though these are much taller. When 4 to 6 inches of a good stand can be taken the yield should be about 1 ton per acre.

A number of trials have been conducted in an attempt to show which variety will produce the highest yields. It is difficult to draw broad conclusions from the data, the value of which is mainly local. The records can be found in bulletins from the State agricultural experiment stations. In general, it seems evident that where conditions are favorable, Tennessee 76 will outyield the others. In more northern latitudes or at higher elevations Korean has outyielded the others. Kobe has sometimes outyielded both, but usually the yields from Kobe have not been very different from those from Korean or Tennessee 76. Common lespedeza has also yielded well in the southern parts of the lespedeza range but not so well in the northern part or at higher altitudes. In some cases it is evident that the hay was harvested at a time that put one or another variety at a disadvantage. Korean, for example, will probably outyield the other varieties if the hay is harvested in early August, but not if the harvest is delayed until late September.

HAY GRADES

Until recent years there were no recognized standards for lespedeza hay although it has been on the market since 1880. Hay was often bought in the South on the standards established by the National Hay Association, but the grades established by this association did not include lespedeza hay. In 1911 the Louisiana Lespedeza Growers' Association (*4*) adopted certain grade definitions, but these were never widely used and appear to have had little effect on the quality of hay produced in Louisiana even at that time.

The Department of Agriculture, after a careful study of lespedeza and its mixtures, established certain standards, which went into effect November 1, 1934, and were revised as of April 1, 1936 (*39*). These standards provide for five classes with various grades. The classes are lespedeza, lespedeza light grass mixed, lespedeza light Johnson mixed, lespedeza heavy grass mixed, and lespedeza heavy Johnson mixed. In each class the grades depend on the percentage of leaves, green color, and foreign material. Hay of grade 1 in the first three classes given above must contain not less than 45 percent of leaves, the color must be green to greenish brown, and the hay must not contain more than 10 percent of foreign material. The other two classes, lespedeza heavy grass mixed and lespedeza heavy Johnson mixed, have the same requirements for foreign material and color, but leafiness is not a grading factor. The lower grades have less stringent requirements than grade 1. The fact that some lots may be extra leafy or extra green is recognized by appropriate designations as U. S. No. 1, Extra Leafy Lespedeza, or U. S. No. 1 Extra Green Lespedeza (fig. 13).

The demand for high-grade lespedeza hay should increase at least in the South since such hay is nearly equal to the best alfalfa for feeding purposes, can be produced locally, and can be bought on definite grades thus insuring quality.

Unfortunately most of the lespedeza hay marketed is of such an inferior grade, chiefly because of the presence of weeds and baling from the windrow in an undercured condition, that not only is the feeding value of the hay reduced but often the hay is unsalable (fig. 14).

Growers need to make a distinct effort to eliminate the weeds and to cure the hay properly. The hay grades established recognize the fact that lespedeza hay will always be somewhat more weedy than alfalfa, but so long as most of the lespedeza hay offered is of grade 2 or 3 and much of it goes as Sample grade on account of foreign material or mold, it can never capture any but local markets. Weeds should be clipped and lespedeza for hay grown on land as free of weeds as possible.

LEAF MEAL

Lespedeza leaves, like alfalfa leaves, may be ground into meal, but the extent of the practice is not known. So far as the writer knows, only one experiment on the value of such meal has been recorded. At the Kentucky station, Buckner and his associates (*3*) found that lespedeza-leaf meal had the same feeding value for chicks

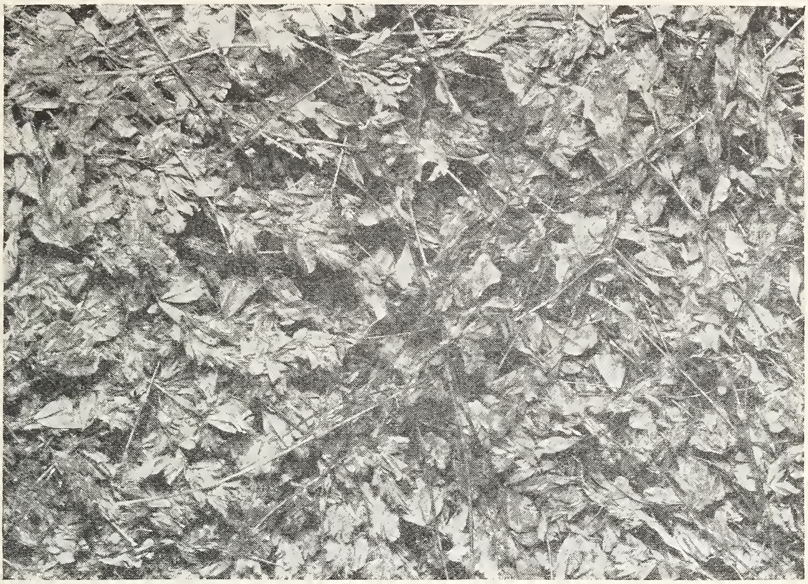

Figure 13.—A sample of No. 1 Korean lespedeza hay.

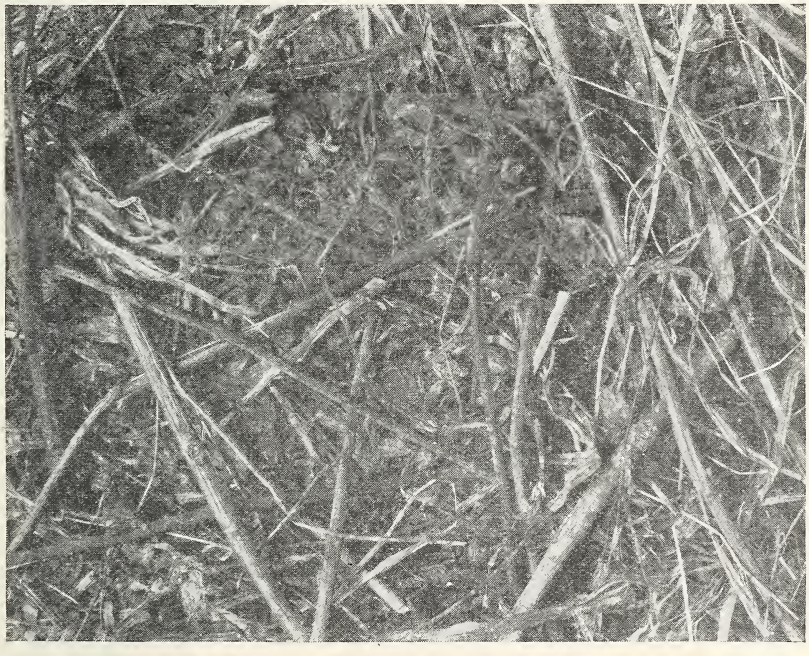

Figure 14.—A sample of low-grade Korean lespedeza hay.

as alfalfa meal, though, on a basis of equal quantities, the plant protein in both legumes was inferior to the animal protein of dried skim milk or meat scrap.

WEEDS IN LESPEDEZA

The lespedezas, while they live in competition with summer weeds more successfully than clover, have little ability to suppress weeds. Hence it is advantageous to seed on grain; the grain suppresses the early weeds and enables the lespedeza to get a start. Later growing weeds are sometimes abundant, especially on fertile land, and can be handled only by clipping. Clipping should be done before the lespedeza has attained much growth or the mower should be set high enough to miss most of the tops.

A heavy growth of weeds results in poor hay and much trouble in harvesting and cleaning the seed crop. The absence of weeds on fields previously in well-cultivated corn or cotton is one advantage in seeding lespedeza on grain following these row crops. A good volunteer stand is sometimes less weedy than a first year's stand, but commonly weeds get an increasing foothold as one crop of lespedeza follows another unless the lespedeza is well grazed. When weeds are increasing unduly the field should be put into a row crop and the weeds killed off. One advantage of the grain-lespedeza rotation previously described is that the annual disking and the growth of the grain holds down the weeds, and the lespedeza can be kept fairly clean of weeds for several years.

The worst weed in lespedeza fields is dodder (fig. 15). This plant is a parasite and attaches its orange-colored stems to the host. The

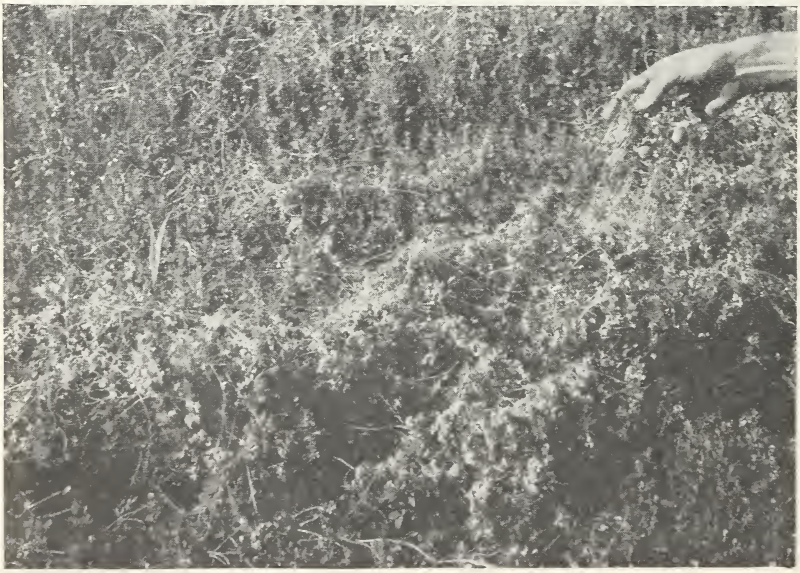

FIGURE 15.—Dodder on lespedeza.

dodder tends to run over the top of the lespedeza, and the affected spots are readily seen. If they are not too numerous or too large, these dodder patches may be destroyed. Some cut them out with a sickle or scythe, cutting close to the ground; others use a sharp hoe and hoe out lespedeza and all. Care must be taken to get all the dodder, the branches of which spread several feet from the center of the patch. In order to prevent the spread of dodder, which is rapid after vigorous growth begins, it is best to begin cutting as early as any dodder can be seen. The cut growth should be removed from the field.

Burning has been tried, using either a kerosene spray or a blow torch on the dodder patches. The Tennessee station (*7*) recommends the use of a 3-percent solution of sulfuric acid applied in a fine spray from a brass container. It is doubtful whether any of these burning or spraying methods are any more economical than hand-cutting.

If there is a great deal of dodder, the most satisfactory way to eliminate it is to graze heavily. Cattle eat the dodder readily, and when grazing is done before seed ripens no seed will pass with the manure. If lespedeza is grazed down during July a new growth of lespedeza will come from which a seed crop can be taken in fall.

Cutting the hay in early July and wherever necessary taking the second growth for hay will go far to control dodder. Just how long dodder seed will remain viable in the ground is not known, but indications are that it may remain for many years. Hence, the feeding of hay containing ripe dodder is dangerous as the dodder will be spread in the manure. Eternal vigilance is the only solution to the dodder problem. Good seed-cleaning equipment will remove nearly all the dodder seed, and it pays to buy dodder-free seed.

SEED PRODUCTION

The area in which lespedeza seed is produced is as wide as the lespedeza area. From Champaign, Ill., to the Gulf of Mexico, and from the Atlantic to eastern Kansas and Oklahoma, seed of one variety or another is regularly harvested.

Much more seed is harvested than appears in trade, and there are no satisfactory data by which the total crop may be measured. In table 6 figures for the years 1927 to 1934 from Seed Statistics (*40*) have been combined with figures for 1935 to 1938 from Crops and Markets (*41*). The tables do not tell the whole story but they suggest the increase in seed acreage and production due to the introduction of new varieties, especially Korean. The production of seed between 1925 and 1928, shown only for Tennessee, Mississippi, and Louisiana, represents common lespedeza with some Tennessee 76 in Tennessee. In 1929, because of the rapidly increasing production of Korean lespedeza seed in Kentucky and North Carolina, those States entered the record and in 1932 Virginia was first added to the list of producing States. Missouri is not shown as a producing State before 1935, but it is known that more seed was produced in that State in 1935 than appears in the record and considerable quantities even earlier. The imperfection of the available statistics is further shown by the reports of county agents for 1936. One county in northern

TABLE 6.—*Lespedeza seed: Acreage harvested and production, 1925–38*

State	Average 1925–26 [1]		1927 [1]		1928 [1]		1929 [1]		1930 [1]		1931 [1]		1932 [1]	
	Acreage harvested	Production	Acreage harvested	Production	Acreage harvested	Production	Acreage harvested	Production	Acreage harvested	Production	Acreage harvested	Production	Acreage harvested	Production
	Acres	*1,000 pounds*	*Acres*	*1,000 pounds*	*Acres*	*1,000 pounds*	*Acres*	*1,000 pounds*	*Acres*	*1,000 pounds*	*Acres*	*1,000 Pounds*	*Acres*	*1,000 pounds*
Indiana														
Illinois														
Missouri														
Virginia													5,000	1,188
North Carolina							13,000	1,950	15,000	1,875	25,000	4,062	41,000	5,638
Kentucky							4,000	800	10,000	1,500	23,000	4,600	46,000	9,775
Tennessee	6,000	488	10,000	1,000	10,000	1,000	24,000	4,200	52,000	8,450	115,000	21,563	92,000	24,150
Mississippi	27,000	3,700	31,000	4,812	24,000	2,820	4,000	450	3,000	202	3,000	395	3,000	227
Arkansas														
Louisiana	13,000	1,712	5,000	703	6,000	780	7,000	578	3,000	113	2,000	225	1,000	120
United States [5]	46,000	5,900	46,000	6,515	40,000	4,600	52,000	7,978	83,000	12,140	168,000	30,845	188,000	41,098

State	1933 [1]		1934 [1]		1935 [2]		1936 [3]		1937 [4]		1938 [4]	
	Acreage harvested	Production	Acreage harvested	Production	Acreage harvested	Production	Acreage harvested	Production	Acreage harvested	Production	Acreage harvested	Production
	Acres	*1,000 pounds*	*Acres*	*1,000 pounds*	*Acres*	*1,000 pounds*	*Acres*	*1,000 pounds*	*Acres*	*1,000 pounds*	*Acres*	*1,000 pounds*
Indiana									20,000	2,900	25,000	5,625
Illinois					15,000	1,950	3,000	300	23,000	3,910	28,000	6,440
Missouri					25,000	3,250	10,000	1,000	40,000	8,400	80,000	21,600
Virginia	10,000	2,625	20,000	4,750	20,000	4,000	16,000	3,200	27,000	6,750	30,000	7,500
North Carolina	50,000	5,625	50,000	8,125	92,000	15,640	92,000	13,800	140,000	26,600	177,000	38,940
Kentucky	91,000	18,200	91,000	15,925	118,000	23,600	88,000	13,200	132,000	26,400	166,000	49,800
Tennessee	165,000	39,188	83,000	18,675	96,000	11,712	57,000	6,270	143,000	35,035	172,000	54,180
Mississippi	2,000	200	2,000	167	1,400	126	2,100	168	3,000	360	2,500	250
Arkansas									10,000	2,000	20,000	4,600
Louisiana	2,000	150	1,000	188	2,900	232	3,700	426	3,000	300	2,500	275
United States [5]	320,000	65,988	247,000	47,830	370,300	60,510	271,800	38,364	541,000	112,655	703,000	189,210

[1] From Seed Statistics (*40, p. 18, table 34*).

[2] From Crops and Markets (*41, v. 13, p. 423*).

[3] From Cropa and Markets (*41, v. 14, p. 269*).

[4] From Crops snd Markets (*41, v. 15, p. 276*).

[5] Additional quantities in other States but data insufficient for preparing estimates.

Alabama produced more than 28,800 pounds of seed in 1936 and one county in Georgia produced 189,450 pounds. Neither State appears in the record.

Since 1932 acreage and production have rapidly increased in all States except in Mississippi and Louisiana where production has declined. These are the States producing the bulk of the common lespedeza seed, though considerable common lespedeza seed is also produced in North Carolina and Tennessee.

The bulk of Korean seed comes from North Carolina, Tennessee, and Kentucky. Missouri probably produces more than table 6 indicates. Illinois and Virginia are increasing their output, and, though not shown in table 6, some is known to be produced in southern Iowa and in southern Indiana. While the available figures are known to be incomplete, they do show the areas of increasing production. Prices have shown a downward trend since 1920, reflecting an increase in production, and this decline became sharper in 1932. The average wholesale price on the markets of Baltimore, Md., Louisville, Ky., and St. Louis, Mo., for 1920 was $33.63 per 100 pounds (*40*). In 1932 this wholesale price for high-quality seed was $8.13. For 1933, 1934, and 1935 the average wholesale price was about $6.51, and the average retail price in all States reporting for these years was $9.63.

SEED YIELDS

Yields of seed vary widely, depending more on conditions than on the variety, though Korean is commonly the heaviest yielder. Under good conditions, the varieties of the striata group should yield 150 to 300 while Korean should yield 300 to 400 pounds per acre. Much heavier yields of Korean have been reported. A North Carolina farmer harvested 1,240 pounds of Korean seed per acre from 2.1 acres. All conditions were ideal, and an extremely heavy crop was made and saved—usually a considerable quantity of seed is left on the field. The yield of the striata varieties will depend in part on whether the seed is pan-caught only or the straw threshed. In North Carolina the average yields reported for Tennessee 76 were: pan-caught only, 250 pounds per acre; panned and threshed, 375 pounds; and for Kobe: pan-caught only, between 250 and 300 pounds; panned and threshed, 400 pounds.

Some idea of average yields on large acreages may be obtained by using the acreage and production figures in tables 6 and 7. It would appear that the average yields are lower than they should be. Even in such States as Illinois, Missouri, Kentucky, Virginia, and North Carolina, where Korean makes up the bulk of the crop, the average yields reported seldom equal 200 pounds per acre. In the South yields have apparently often fallen below 100 pounds per acre.

A moderately good stand will produce more seed than a very thick stand. This is especially true of Korean. In a thick stand, the plants of Korean are so close together that they cannot branch. Consequently, each plant bears seed only at the end of the main stem instead of on the ends of numerous branches. Early grazing or taking an early hay crop will usually result in a larger seed crop than would have been secured without grazing or cutting hay.

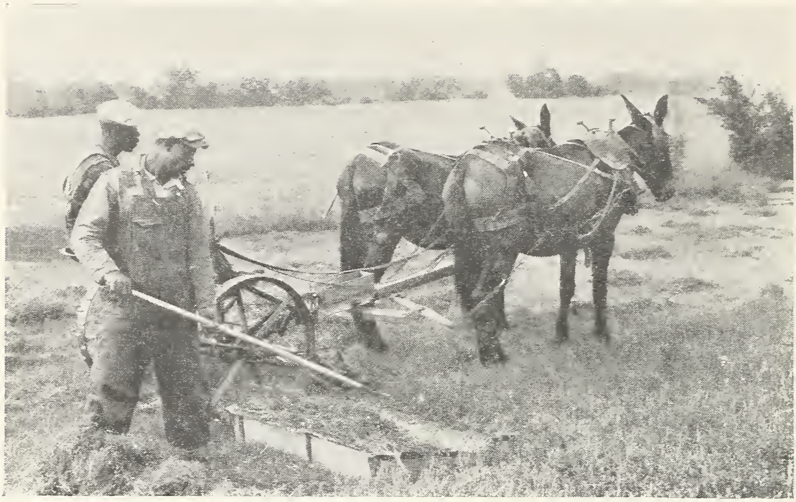

FIGURE 16.—Harvesting lespedeza with a seed pan.

HARVESTING

Seed of the striata varieties, common, Tennessee 76, and Kobe. is generally harvested with a seed pan (fig. 16). This is a shallow metal pan bolted to the cutter bar. The back of the box is 6 to 8 inches high and the sides slope to the cutter bar. The box has a hinged metal cover that is perforated with holes just large enough for the lespedeza seed to fall through. In order to dislodge the seed, a man or boy walks behind the pan while the ripe lespedeza is being cut and rakes the material over the perforated cover. Homemade reels have been made to push the cut material over the pan so that the extra man would not be necessary. There are several makes of pans on the market, and many farmers make their own.

After a field has been panned, the hay may be threshed if all the seed is wanted. The hay will be in better condition without threshing, but even though the threshed straw is not so good as unthreshed hay it makes fair roughage, especially if it has not been rained on. For the individual small farmer who merely wants seed for his own use, a good method is to cut common lespedeza when the older seeds are ripe but the plants are still green and growing. The pan will get these ripe seeds and the quality of the hay will still be fair.

Some of the larger growers of Korean lespedeza use the special lespedeza seed harvesters that are obtainable (fig. 17). In many cases a small combine has been used to cut and thresh at one operation. The combine may also be used to pick up the lespedeza and thresh out the seed.

Korean lespedeza does not shatter so readily as common and the use of a pan is usually not profitable. Cutting should be done when the leaves have turned brown and the seed is ripe. If the lespedeza is cut in the early morning while the plants are still moist and is immediately raked into windrows, little loss of seed will occur.

Threshing may be done in the afternoon of the same day. A side-delivery rake is commonly used to put the swaths into windrows and the crop is brought to the threshers with push rakes. Threshing is done with a grain separator properly adjusted; combines have been used. A clover huller will do the work if adjusted so as not to hull the seed. Hulled seed is undesirable as it is more difficult to separate from the dodder than the unhulled seed.

Korean holds its seed so well that little loss occurs in the windrow even if threshing is considerably delayed. Good yields have been secured from crops left in the windrows in the field as late as January or February. In some cases fields have not been cut until January and have still produced a good seed crop. If the plants are short, as they will be in a dry summer or on infertile soil, a fairway, or low-hung, cutter bar may be used. It is said that this bar is advantageous even if the plants are not short, as the rapid cutting reduces shattering, especially in harvesting Kobe. Korean lespedeza for seed should not be cut on the "green side" because this results in much immature seed with consequent lowering of germination.

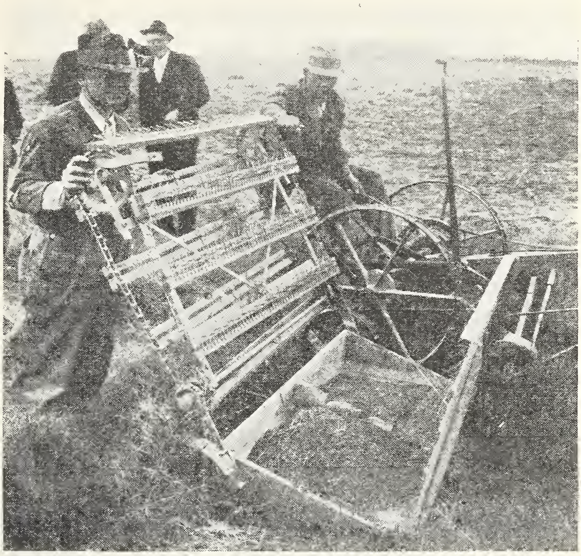

FIGURE 17.—A special lespedeza seed harvester.

RECLEANING

The seed must be recleaned to take out such weed seeds as ragweed, povertyweed, and dodder. Dodder seed is nearly the same size as that of lespedeza, except Kobe, which is larger. In pan-caught lespedeza, the dodder is mostly in the pod, or puff as it is sometimes called, and these pods are easily cleaned out with the trash. In threshed lespedeza the pods are broken and the individual dodder seeds are nearly the same size as the lespedeza seed. Care must be taken therefore in the proper adjustment of sieves to remove all or nearly all this dodder. The larger growers are equipped to do their own cleaning, and seed from small producers is commonly bought on its appearance and assembled by dealers who have cleaning equipment.

A system of certification exists in all States in which the improved varieties are grown for seed. In general, both field and bin inspection are provided, and seed eligible for certification must meet certain requirements for trueness to variety, purity, germination, and freedom from weed seeds, especially dodder.

APPEARANCE OF SEED

Lespedeza seed is always marketed and sown in the hull with the calyx attached. The seeds of common and of Tennessee 76 are indistinguishable. In both, the pods are surrounded with the calyx, the five lobes of which are nearly as long as the pod and bluntly pointed. The pods are pointed and faintly reticulated. The hulled seeds are mottled. They are shaped much like red clover but are smaller. The pods of Kobe resemble those of common in shape but are decidedly larger and not so sharply pointed. The pods of Korean are more rounded, blunt, and strongly reticulated, and the calyx lobes are about

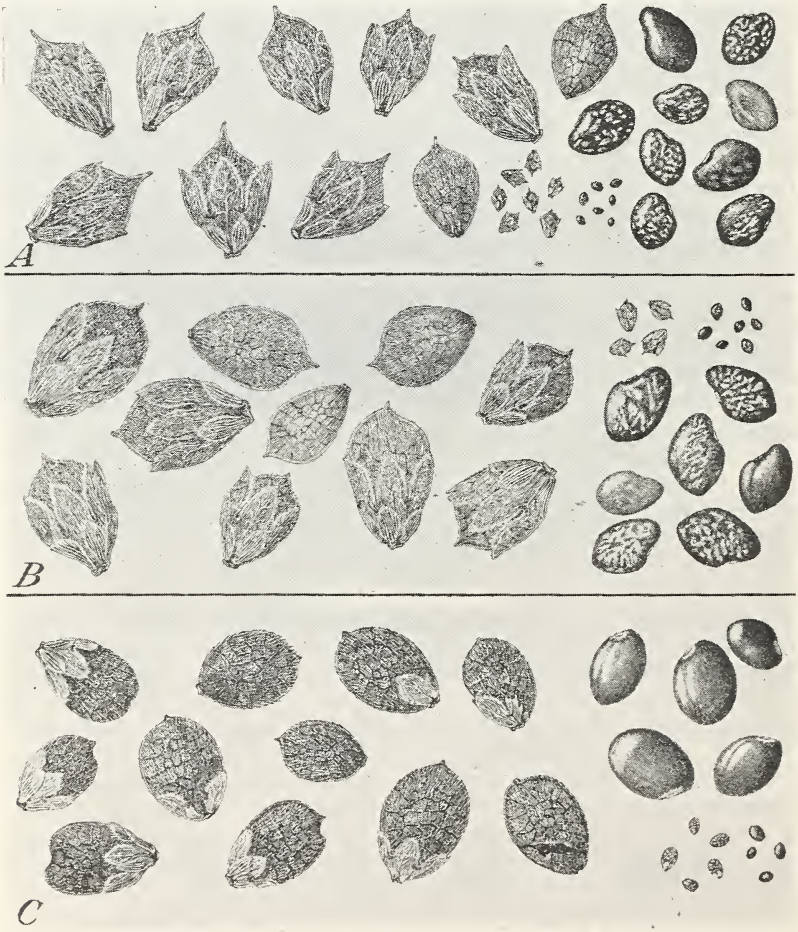

FIGURE 18.—Hulled and unhulled seed of common (*A*), Kobe (*B*), and Korean (*C*) lespedezas.

one-fourth as long as the pod and are rounded. The hulled seeds of Korean are black or blue black (fig. 18).

WEIGHT OF SEED AND NUMBER PER POUND

The legal weight of a bushel of common lespedeza seed in North Carolina and Arkansas is 25 pounds. Other States have not established legal weights but 25 pounds is generally accepted as the bushel weight of lespedeza seed. The actual weight of well-cleaned common lespedeza seed is somewhat higher, and the bushel weight of Kobe and Korean is considerably higher, as may be seen from table 7. The number of seeds per pound varies also with the purity of the seed. The approximate number of unhulled seeds per pound as determined by the Division of Forage Crops and Diseases, Bureau of Plant Industry, is also given in the table.

TABLE 7.—*Weight per bushel and approximate number of seeds per pound of common, Tennessee 76, Kobe, and Korean lespedeza*

Variety	Weight per bushel		Approximate unhulled seeds per pound
	Unhulled	Hulled	
	Pounds	*Pounds*	*Number*
Common	28.7	59.4	342,600
Tennessee 76	27.7	60.5	342,600
Kobe	30.15	58.7	185,000
Korean	44.6	59.0	240,000

DISEASES

The annual lespedezas are relatively free from bacterial or fungus diseases or insect attack. All lespedezas in the greenhouse have been observed to be rather susceptible to the attack of damping-off fungi, and lespedezas in the field may be susceptible also, though exact observations are wanting.

Korean lespedeza is often attacked by the southern blight (*Sclerotium rolfsii*), especially in the southern extension of its range. At the Arlington Experiment Farm, a few diseased plants are noted nearly every year. Attacks severe enough to be of economic importance are, however, extremely rare. In Illinois (*31*) a leaf spot has been observed on the striata varieties but the stipulacea varieties appeared unaffected.

A bacterial disease has been observed at times to be serious on the early Korean 19604, but other varieties appear to be nearly free from this disease. Studies now in progress by the Bureau of Plant Industry have shown that the disease may be produced on several varieties of the annual lespedeza even though in the field destructive effects at least appear to be confined to the early Korean.

A rust is common on the American wild species of lespedeza but has not been observed on the introduced species. A similar form of rust has been reported on species of lespedeza in the Orient, including the annual species, however, and it would appear that there are two physiological races of this rust—one confined to the American lespedezas, the other to the oriental species. Care should be taken not to introduce the oriental form into this country.

INSECTS

The lespedezas are as free from insect pests as from diseases. Insects occasionally feed on the foliage but do so little damage that loss from this source is never noticeable.

LESPEDEZA IN ROTATION

While the short rotations described are essentially grazing rotations, lespedeza fits well into longer rotations. In the South winter grain properly fertilized may be seeded on disked cotton, tobacco, or corn ground, and the lespedeza seeded in the grain may be left down for 2 or 3 years and utilized for pasturage, hay, or seed. Land that is plowed for cotton or corn in spring after having been in lespedeza several years will have been protected most of the time. If proper contour or other soil-conserving methods are used on the row crop, erosion will be reduced to a minimum.

Farther north Korean lespedeza may, under some conditions, replace red clover in the standard rotation, the volunteer stand taking the place of second-year red clover. Indeed on many soils marginal for red clover, lespedeza has an advantage in being more dependable. Failure of the legume crop in a rotation with lespedeza is rare. In such a rotation grain can be seeded in the lespedeza sod, thus getting better use of the land and more continuous plant cover. Lespedeza being an annual is fitted for a temporary place in the rotation so that any desired changes are made more readily than in the case of a biennial legume.

Many rotations have been suggested by the agricultural experiment stations, but the general principles of all are the same. A row crop—corn, cotton, tobacco, or soybeans—is followed by grain with lespedeza in the grain. The lespedeza is allowed to volunteer as long as desired with or without grain each year, and finally the sod is spring-plowed for a row crop. On land subject to erosion, a long rotation will protect the ground most effectively, and with proper fertilizing of the grain the lespedeza will make a dense growth each summer.

The Missouri station (*9*) has found that on land on which several seed crops of Korean lespedeza have matured the lespedeza will volunteer when the land has been in corn 1 year and is later plowed for oats. Enough hard seed appears to remain under the ground for a stand when the soil is again turned up.

EFFECT OF LESPEDEZA ON SOIL PRODUCTIVITY

It is well known that yields of corn and cotton are larger following lespedeza, especially when this has been left down 2 or 3 years, but experimental data are few. In the dark-tobacco sections of Tennessee and Kentucky, lespedeza is sometimes left to fall on the ground for 2 or 3 years before the field is again planted to tobacco. In practice lespedeza is not commonly turned down for a following crop (fig. 19). The increased yields observed have been secured after the lespedeza has been utilized as hay or pasturage or for seed production, and while they may form a practical measure of the value of lespedeza in the rotation they cannot measure its full value as a soil improver.

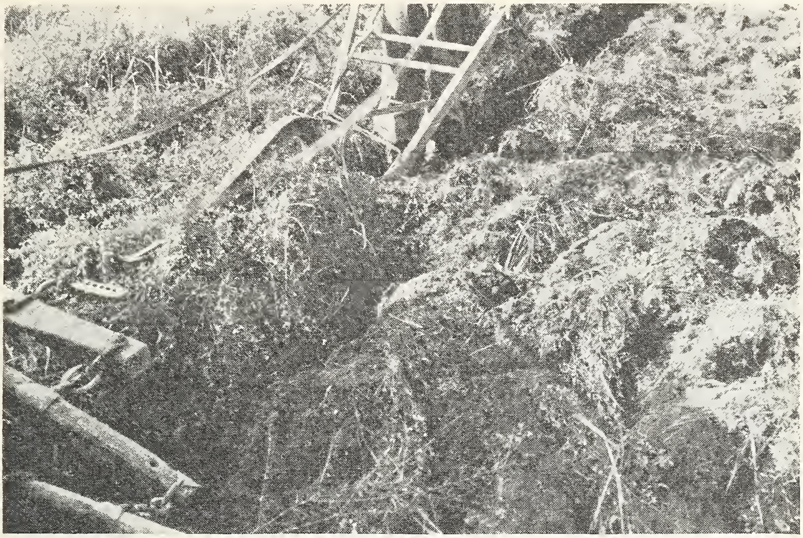

FIGURE 19.—Turning under lespedeza for soil improvement in Virginia.

The North Carolina Extension Service (*1*) records that a crop of corn after lespedeza turned under yielded 44.1 bushels per acre while without lespedeza the yield was 21.3 bushels. The Tennessee station (*22*) records the result of certain experiments in which the green-manuring value of sweetclover and lespedeza were compared. On land suited to sweetclover the total yield of five corn crops after sweetclover was 272.4 bushels, after lespedeza 241.4, after orchard grass 220.6, and on continuous corn plots only 154.9 bushels. Sweetclover in this experiment was cut for hay every year and lespedeza every year but one.

The North Carolina station[8] determined yields of corn after turning under a crop of lespedeza. Large increases were secured in every case and these averaged more than 100 percent for six trials covering 3 years. At the South Carolina station a substantial increase was noted in the productivity of the soil after lespedeza was turned under (*29*).

Peele and Latham[9] record the results of an experiment in South Carolina in which a part of a cottonfield followed lespedeza turned under in spring and a part followed cotton. The yields were determined from boll counts and showed that the cotton following lespedeza yielded 61 percent more seed cotton per acre than that following cotton.

Miller (*21*) made a study of farm results in North Carolina, Kentucky, and Tennessee. On these farms the lespedeza had been utilized for hay, pasturage, or seed, and the results reported thus represent the effect on the yields of corn and cotton of growing lespedeza from 1 to 3 years and getting full value of the crop. The increase in corn yields varied from 60 to 257 percent, averaging for all farms 113 percent (fig. 20). The increased yields of cotton in North Carolina and Tennessee varied from 33 to 199 percent from fields that had been in lespedeza from 1 to 3 years. One field in which cotton followed 4 years of lespedeza gave an increased yield of 540 percent. The average increase for 10 farms representing 193 acres was 142 percent. The percentage of increase is commonly greater on poor soils much in need of nitrogen and organic matter than on good soils.

---

[8] BLAIR, E. C., and KIME, P. H. GROWING LESPEDZA IN NORTH CAROLINA. N. C. Ext. Serv. and U. S. Dept. Agr. Agron. Inform. Cir. 26, 4 pp. 1929. [Mimeographed.]

[9] PEELE, T. C., and LATHAM, E. E. THE PRACTICAL VALUE OF COMMON LESPEDEZA FOR EROSION CONTROL AND MAINTENANCE OF SOIL FERTILITY. S. C. Expt. Sta. and U. S. Soil Conserv. Serv. Tech. Contrib. 44. 1935. [Mimeographed.]

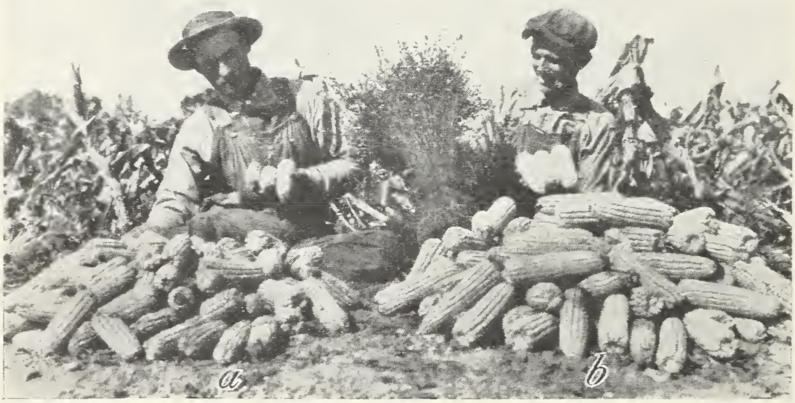

FIGURE 20.—Lespedeza has increased corn yields: *a*, 25 bushels per acre of poor-quality corn without lespedeza; *b*, 46 bushels per acre of good-quality corn on the same field after lespedeza.

The great value of lespedeza in the soil improvement program lies in part in its economy. When properly managed, it may even bring some revenue while improving the soil. The time element must here be set off against a relatively heavy cash outlay for quick results.

Wasson (*42*) records that a sandy loam farm, so badly worn and eroded that it produced only 100 pounds of lint cotton per acre, with 200 pounds of 2–8–2 fertilizer was brought back to productivity by adopting a rotation of 2 years of lespedeza and 1 of cotton. The lespedeza was cut for hay where it was tall enough. After several years of such a rotation, the same field produced 660 pounds of lint cotton per acre with 95 pounds of 16-percent superphosphate. Even if some part of this result is credited to a favorable season or other favorable conditions a large part was certainly due to the gradual beneficial effects of the lespedeza.

Numerous examples of increases in yields of cotton, corn, wheat, and oats when grown after 1 to 3 years of lespedeza could be cited from data furnished by farmers or by county agents. In nearly every case the lespedeza was harvested for hay or seed and no cost could be charged against the increased yields secured. Even after making due allowance for the possible effect of seasonal variations on yield, the fact that growing lespedeza has a good effect stands out boldly. If run-out land were seeded to lespedeza instead of being allowed to lie bare and exposed to erosion, the practice would pay handsomely apart from the effect of the lespedeza in the prevention of soil erosion.

LESPEDEZA IN ORCHARDS

Korean lespedeza has been used with some success as a cover crop in apple and peach orchards in Illinois, Kentucky, and Virginia. Being a summer-growing crop, it does not deprive the trees of moisture in early spring; it shades and covers the ground during summer, preventing erosion and adding organic matter and nitrogen to the soil. Its growth is not high enough to interfere with harvesting operations, and once established it covers the ground in winter with a mass of debris that also impedes water flow and prevents erosion.

The ground may be disked in early spring without interfering with the volunteer stand. Lespedeza will grow in considerable shade and so is well suited to older orchards. If weeds become abundant the growth may be clipped. Even if the lespedeza is cut short, enough seed will be produced for a volunteer stand.

EROSION CONTROL

Soil erosion is today recognized as one of the major problems not only in agriculture but also in the control of floods and silting of reservoirs with the consequent damage to irrigation and power development. The Soil Conservation Service is making progress in erosion control, using all available methods—engineering projects, suitable cropping systems, strip cropping, and revegetation. In all these methods except engineering projects the controlling thought is to keep the ground covered as much of the time as possible. In this work, lespedeza plays a great part and will undoubtedly play a greater.

Naturally, the ability of lespedeza to protect the soil will depend on its capacity to grow under the given conditions. Where, by reason of the extreme infertility of the soil, dry springs, or other conditions, lespedeza can make but a scanty growth, an application of fertilizer must first be made in order that the lespedeza may be able to play its great role adequately and well. Under some conditions, other crops such as kudzu must be selected.

That lespedeza, when well grown, will go far to control erosion has been proved by a number of experiments conducted by the Soil Conservation Service, as well as by numerous less exact observations made by farmers. On the South Tyger River project (*30*),[10] run-off and soil loss were measured on plots planted to cotton and to common lespedeza. During June, July, August, and September 1935, the run-off from cotton plots was 17.93 percent and the soil loss 17.87 tons per acre. From the lespedeza plots, the run-off was 10.76 percent and the soil loss only 1.18 tons per acre. From another series of plots, the water coming from the lespedeza plots was much clearer than that from the cotton plots as shown by the fact that only 2.5 pounds of soil were suspended in 1,000 gallons of run-off from the lespedeza plots whereas that from the cotton plots contained 8.3 pounds of soil per 1,000 gallons of water. In July of that year, when the lespedeza was in full growth, a rain of 3.85 inches fell in 1 day. As a result of that rain, an area in cotton lost 31,400 pounds of soil, that in lespedeza only 800 pounds.[11] Terraces planted to lespedeza showed 55 to 90 percent less soil in the run-off water than terraces planted in cotton (*30, p. 28*).

---

[10] See footnote 9.

The Missouri Agricultural Experiment Station (*9*) reports the results of some observations made on the soil conservation station at Bethany, Mo. Here the remains of a stand of Korean lespedeza in 1933 covered part of the area, and this debris allowed very little if any run-off from January 1 to April 1. Even a torrential rain early in April caused little run-off, though the volunteer lespedeza was not yet large enough to offer much protection. For the entire calendar year the run-off from the lespedeza plot was 11.7 percent of the rainfall, and the soil loss was only 1.6 tons per acre. During this time a plot in continuous corn lost 60.8 tons of soil and 30.3 percent of water in run-off. From 1931 to 1935 at Statesville, N. C., the run-off and soil loss from four plots were recorded by the Soil Conservation Service. The average annual soil loss and percentage of run-off are shown in table 8. The control of erosion by the lespedeza improved after the first season, as the stand became more dense.

TABLE 8.—*Average annual soil loss and percentage of run-off from four plots at Statesville, N. C., 1931–35*

Plot	Average soil loss	Average run-off
	Tons	*Percent*
Fallow	64.56	29.60
Corn	20.19	9.21
Cotton	13.87	8.79
Lespedeza	.63	5.61

These exact measurements confirm the observations of experiment-station workers and farmers as to the value of lespedeza in controlling soil loss. Even the debris left by the dead plants during winter is valuable. Better still is winter grain seeded in the lespedeza sod. This substitutes a living crop for dead material and besides uses the land to better advantage.

There are millions of acres of idle land in the South, some of it used as so-called pasture. This land is eroding and gullies are forming. It could be saved and made profitable by lespedeza. Wasson (*42*) says: "It would be impossible to estimate the value of lespedeza as a soil holding plant * * * with lespedeza the ruinous effects of erosion on hillside pastures can be completely overcome in from two to three years." Where the land is too poor to produce good lespedeza, an application of phosphate or of lime would pay dividends.

---

[11] CARNES, E. SOME PHASES OF VEGETATIVE CONTROL IN THE SOIL CONSERVATION PROGRAM. 1936. [Mimeographed.]

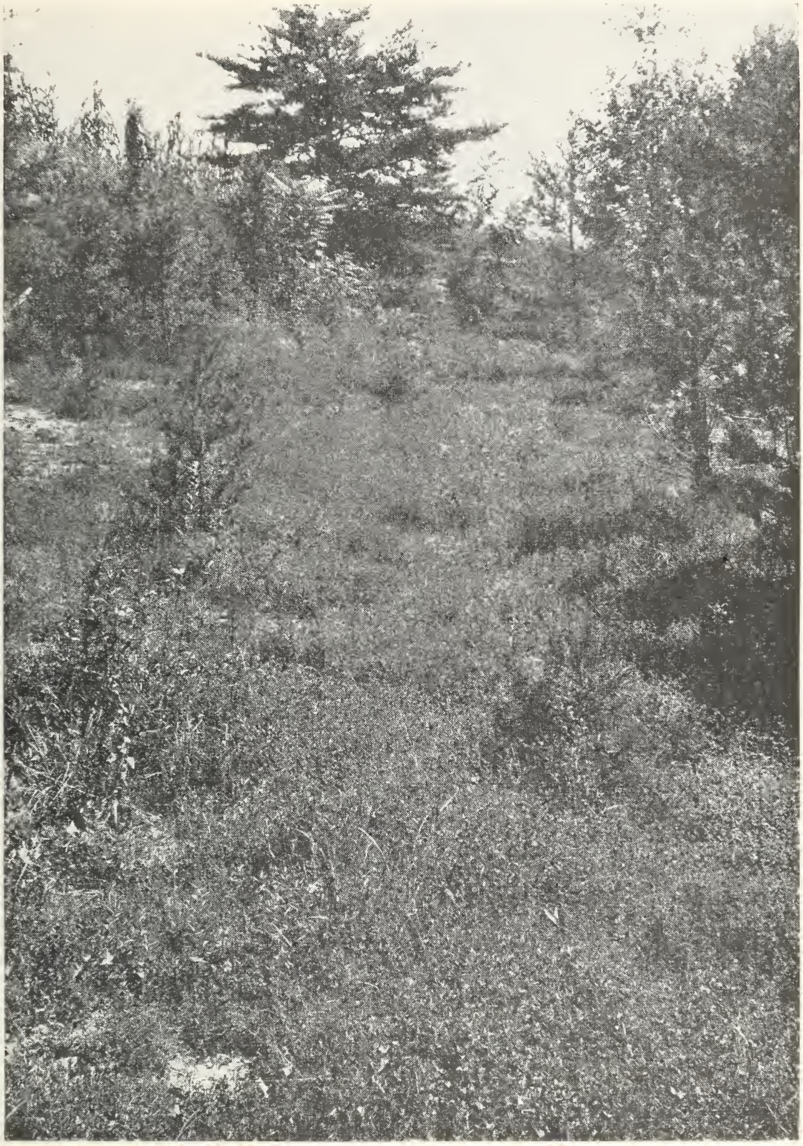

FIGURE 21.—Second-year volunteer Korean lespedeza protecting a galled and gullied area in North Carolina.

Lespedeza is a good plant to seed on small gullies(fig. 21) where it will catch silt and gradually fill the gullies, it is good for banks

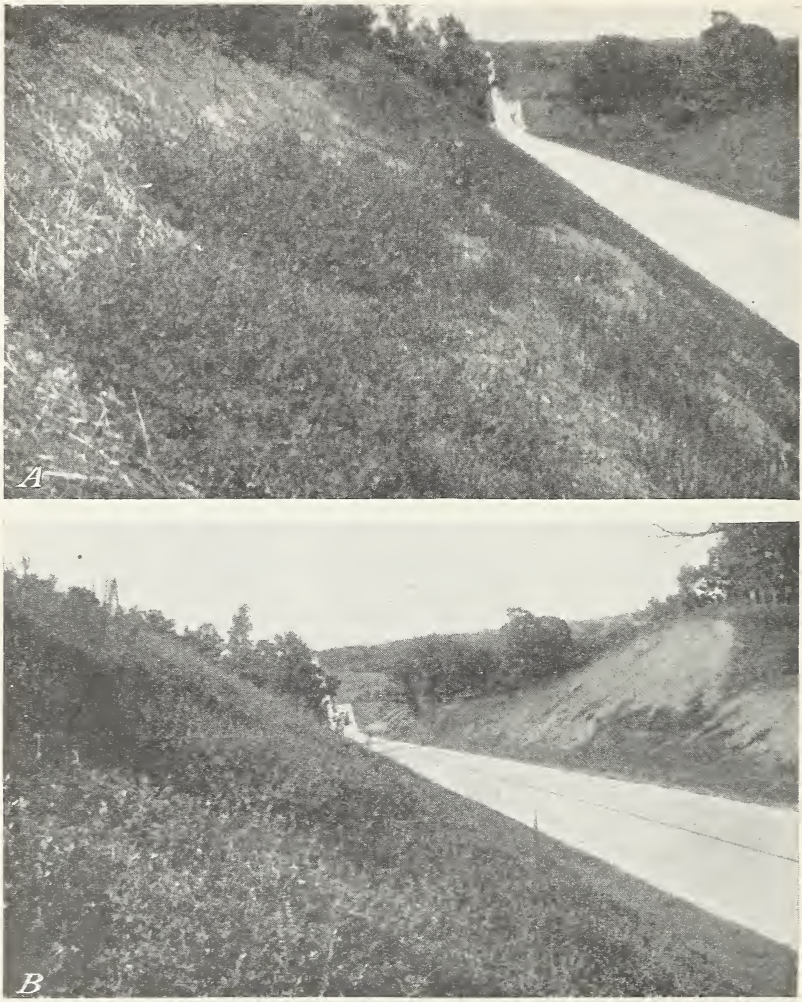

Figure 22.—*A*, Korean lespedeza holding a bank in Illinois, 1934; *B*, the same location 1 year later. (Courtesy of Illinois Agricultural Experiment Station.)

and hillsides (fig. 22) where few other plants can be grown, and it is good for road shoulders, wherever it will reseed. In these places it will help to save and improve the soil. The growth becomes more dense and efficient with time.

An objection voiced against lespedeza is that while it protects the ground adequately during summer, it permits or even encourages erosion during winter. This objection does not rest on experimental data but on observations on certain soils in certain localities. The

Tennessee station[12] says that on certain soil types on which Korean lespedeza was grown continuously for 3 years and was taken for seed, winter erosion was severe. No observations were made on lespedeza used for grazing. On the other hand, experienced and observant farmers in the same part of Tennessee who have used lespedeza mainly for grazing, insist that if erosion occurs it is too insignificant to notice. A farmer in Weakley County, Tenn., insisted that no winter erosion occurred no matter how he used the lespedeza. Experimental data on this point are badly needed. Lespedeza is too important a plant in the soil conservation program to leave its usefulness in any doubt. In some areas in Tennessee, Kentucky, and Missouri it is known that lespedeza played an important role in protecting and improving the soil before any systematic attempt at soil-erosion control was made. In these districts erosion has certainly been checked if not prevented by the cover provided by lespedeza.

While experimental data from the area under discussion are not available some data have been secured in North Carolina and in South Carolina and these indicate that soil loss in winter is small whether the lespedeza is left on the surface or is removed. The soil and water conservation experiment station at Statesville, N. C., has furnished the record of 4 years of water- and soil-loss measurements on areas of Cecil clay loam planted to Kobe lespedeza, to continuous cotton, and to permanent grass sod, and from a bare area. To bring out clearly the effect of lespedeza the data have been arranged by crop season and stubble season. The stubble season covers the period between cutting the lespedeza and spading the ground the following year for the new crop. The water and soil losses recorded during four stubble seasons for the lespedeza ground, the continuous corn ground, the bare ground, and ground covered with sod are shown in table 9.

TABLE 9.—*Soil and water losses from Cecil clay loam plots, variously cropped, at Statesville, N. C., during the periods indicated*

Period	Loss from—							
	Lespedeza stubble		Continuous cotton		Bare ground		Permanent sod	
	Water	Soil	Water	Soil	Water	Soil	Water	Soil
	Per-cent	*Pounds per acre*	*Per-cent*	*Pounds per acre*	*Per-cent*	*Pounds per acre*	*Per-cent*	*Pounds per acre*
Sept. 1, 1934 to Jan. 15, 1935	0.23	20	10.93	8,822	37.77	26,538	0.06	5.0
Sept. 24, 1935 to Apr. 20, 1936	2.33	457	10.36	29,087	19.61	75,856	.23	37.0
Sept. 21, 1936 to Feb. 19, 1937	5.07	206	11.98	7,014	30.72	27,192	.04	2.0
Sept. 23, 1937 to Feb. 8, 1938	.56	28	16.74	8,327	29.61	13,172	.01	.2
Total soil loss		711		53,250		142,758		44.2
Average	2.39	178	11.98	13,312	27.69	35,689	.11	11.0

That this soil is readily eroded is shown by the heavy losses from the bare ground and from the area in continuous cotton, and it is evident that in this case at least the soil loss from the area in lespedeza stubble was insignificant.

---

[12] C. A. Mooers. Letter to author, Sept. 9, 1938.

T. C. Peele of the Soil Conservation Service, Clemson, S. C., has furnished data on the soil loss and run-off from areas continuously in Kobe lespedeza from June 1935 to April 1937. The lespedeza was not cut; the volunteer crop came through the debris, and all growth was left on the ground during the winters of 1935, 1936, and 1937. From the record for June 1935 to April 1937, the soil and water losses for the periods when the ground was covered with dead lespedeza are recorded in table 10.

TABLE 10.—*Rainfall, percent run-off, and soil loss per acre from areas covered with dead Kobe lespedeza and with cotton stalks at Tigerville, S. C., winter seasons, November 1935 to March 1937*

Year and month	Rainfall	Lespedeza		Cotton	
		Run-off	Soil loss	Run-off	Soil loss
1935	*Inches*	*Percent*	*Pounds*	*Percent*	*Pounds*
November	6.05	5.66	125	23.07	1,560
December	1.21	0	0	0	0
1936					
January	12.62	.59	19	7.59	6,966
February	5.45	.21	3	.02	1
March	6.71	1.04	60	24.94	35,415
April	8.52	1.51	31	44.61	38,739
Total 1935–36, winter season	40.56		238		82,681
1936					
November	2.12	.23	0	6.15	10
December	7.12	.18	1	10.11	298
1937					
January	11.67	.57	0	32.59	1,200
February	3.95	.27	1	8.59	480
March	2.02	0	0	0	0
Total 1936–37, winter season	26.88		2		1,988

In the spring of 1936 soil losses from the cottonfield were heavy while the loss from the field covered with lespedeza debris was insignificant. During the winter of 1936–37 soil losses were light and there was almost no loss from the lespedeza area.

To prevent winter erosion after lespedeza, consideration will have to be given to the proper management of the crop. If lespedeza is cut late and short and the crop is removed, there will undoubtedly be more chance for erosion than if the field is conservatively grazed or if a seed crop is taken with a combine and the debris left on the field. It cannot be expected that lespedeza will perform its function of soil protection when every possible spear of growth is removed. Whenever hay is taken it should be cut early enough to permit a second growth to serve for a cover and reseeding.

Where winter erosion occurs on lespedeza, a winter small-grain crop may be included in the rotation. The lespedeza may also be grown in association with a self-perpetuating winter annual grass as is now being done in Montgomery County, Tenn. If a permanent sod of perennial grass can be grown with a good summer stand of lespedeza, this will, of course, make for ideal erosion control. Many badly worn soils are, however, in too low a state of fertility to carry an adequate cover of perennial grasses. In such a case a winter small grain or an annual grass will serve to control soil loss in winter.

USE OF ANNUAL LESPEDEZA IN THE SOIL CONSERVATION PROGRAM

The annual lespedezas are indispensable in the soil conservation program. This program aims at the control or the minimizing of erosion while permitting the agricultural use of the soil as far as possible. The means to this end are in part mechanical, as terracing and contour cultivation, and in part are based on vegetative control. The latter is secured by strip cropping, the vegetative control of waterways, or the retirement of certain fields to woodland or pasture. In all these except retirement to woodland lespedeza plays a part.

The use of lespedeza in the soil conservation program is, therefore, coordinate with the use of this crop in a sound agricultural program. A sound agricultural program must be based on the use of crops that thrive under the conditions that obtain, the development of practices that will control or minimize soil loss while permitting the use of the land, and the adaptation of these practices to the financial condition of the farmers in any localtiy.

A program that aims at substituting a close-growing crop, as barley, for a cultivated crop, as corn, or that provides for a cash crop and a forage crop on the same land the same year with a minimum of soil stirring, as the annual rotation of small grain and lespedeza, is not only economically sound but looks toward the preservation of the soil.

A program that can be carried out on worn soils with a minimum of cash outlay for soil amendments is likely to be more generally accepted than one that calls for the relatively heavy outlay necessary to produce crops not naturally well adapted to the soils available. Results may be slower, but with proper management they are likely to be quite as certain as those secured by programs calling for a relatively heavy initial outlay.

Because it is so admirably suited to the soil and climatic conditions of the southeastern part of the United States, lespedeza fits into the various phases of such a program. Some of these may be briefly considered. The extremely flexible rotation of small grain and lespedeza annually has been referred to and is in use in most of the States of the South. Because of its early maturity Korean lespedeza is usually the variety best adapted to such a rotation, but in North Carolina and South Carolina Kobe is successfully used. Wherever the soil is productive enough, barley can be grown to replace corn as a farm feed and reduce the acreage in cultivated crops. If the farmer grows his own lespedeza seed, the barley may be seeded early enough to serve for winter grazing and the lespedeza reseeded in the spring. Or the barley for winter grazing may follow close drilled or broadcast soybeans cut for hay. This will enable the farmer to use the ripe lespedeza field for the seeding of other grain for a cash crop.

The rotation of small grain and lespedeza will make for excellent erosion control. Wherever spring oats are adapted, they may be used with lespedeza in the same way. In this case a later maturing lespedeza, as Kobe, may be used, as the ground will not be prepared for oats until late winter or early spring. An early, short-straw variety of oats should be selected. The lespedeza debris left either after a seed crop has been taken with a combine so as to leave the straw on the ground or after grazing will serve as an erosion-control cover during winter. The grain should receive an appropriate application of fertilizer. Usually phosphate only will be needed, but if the soil is known to be low in potash this should be included in the formula. The fertilizer will increase growth in the lespedeza as well as the grain.

Another rotation suggested by the Missouri Agricultural Experiment Station (*9*) is a 3-year rotation of corn followed by oats and lespedeza and by wheat in the lespedeza sod that fall. The wheat would be cut for grain and the lespedeza grazed. The following year corn could be planted again or the rotation may be extended by seeding wheat or oats in the lespedeza for 1 or more additional years, thus making the rotation a 4- or 5-year one. In such a 3-year rotation, there is a legume on the ground 2 years out of 3.

The weakness of this rotation from the standpoint of soil conservation is that the ground is bare during the winter following corn. To avoid this, lespedeza may be seeded at the last working of the corn. It will make growth enough for a rather effective cover. Korean has been known to make enough seed when sown at the last working of corn to provide a good volunteer stand in the oats the following spring. Kobe has been successfully used in South Carolina in a grain-lespedeza-cotton rotation. The Kobe is seeded on winter grain, the crop is taken for hay or seed, and the grain is drilled in the lespedeza that fall. The Kobe volunteers in the grain the next season and is again taken for hay or seed. No grain is seeded that fall but the lespedeza debris is left on the field and turned under for cotton the following spring. Cotton may be grown 1 or 2 years. In a variation of this rotation grain was produced the first year only, Kobe was seeded in the grain and allowed to volunteer for 2 years. Seed was harvested every year and after 3 years the field was put into cotton for 1 year. In this variation the ground was occupied for 3 summers with a legume in preparation for 1 year of cotton. The lespedeza pays for itself and leaves a good cover of debris for winter protection.

Another rotation, in use on a soil conservation project in North Carolina, is 1 year of cotton with crimson clover in the cotton. The clover is turned under for corn, and the corn is followed by winter small grain with lespedeza in the grain. The lespedeza volunteers the next year after which cotton is again planted. In this rotation, there is a legume one winter and two summers in a 4-year rotation.

A 4-year rotation suggested for Tennessee but not yet in practice presents some good points. Cotton will be grown 2 years and rye planted each fall to protect against winter erosion. Both crops of rye will be cut for grain. Before seeding the second rye crop, the cotton rows will be disked down so as to make the field level for harvesting lespedeza. Lespedeza will be seeded in the second crop of rye. The first year's lespedeza crop will be taken for seed, the second for hay. The land will then go back to cotton. There would seem to be no reason why the first year's crop of lespedeza should not be cut for hay and the second for seed. If the lespedeza is cut 3 inches high about the middle of July, a good second growth will come for a volunteer seeding. If the second year's lespedeza is taken for seed with a combine the debris will be valuable to turn under for cotton.

The annual small grain-lespedeza rotation may be interrupted in any year to establish a timothy-clover meadow. If during the last summer of such a rotation the lespedeza, especially Korean, is allowed to seed, the heavy volunteer crop may damage the timothy and clover. It is better, therefore, when planning such a rotation to take the last year's Korean for hay, and to cut it so short that seeding will be prevented. The timothy should be seeded with the grain and the clover the following spring. It is usually wise to add a few pounds of lespedeza to the red clover to insure against legume failure. The red clover may fail or produce only a poor stand; Korean lespedeza will not fail.

USE IN STRIP CROPPING

The use of lespedeza in strip cropping is closely related to its use in rotations, as strip cropping is but a special phase of rotation farming. The lespedeza is seeded on grain and left 1 or 2 years before the strip is plowed for a cultivated crop (fig. 23). Often there are two strips—one in first-year lespedeza with grain and one in second-year

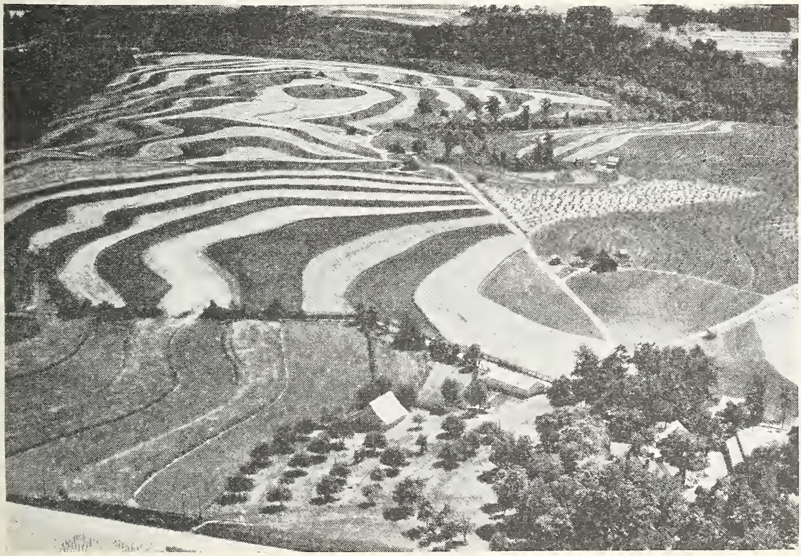

FIGURE 23.—Lespedeza is seeded on the grain in this strip-cropping program.

lespedeza without grain. These are usually side by side. The older lespedeza strip is turned for a cultivated crop, and an additional grain strip is laid down to be seeded for first-year lespedeza. By this 3-year system, two-thirds of the land is covered by erosion-resistant crops.

Another plan that does not give such perfect protection is cotton on one strip, grain and lespedeza on the second, and cotton on the third. The next fall the first strip of cotton is planted to Austrian Winter peas, which are turned under for cotton. Cotton also follows the lespedeza so that the next year two-thirds of the area is in cotton. The other cotton strip goes into grain and lespedeza.

Various modifications of arrangement may be made and the lespedeza may be used for hay or for seed. As far as possible, a large part of the area should be in erosion-resistant grain and lespedeza, and the latter should be allowed to volunteer at least 1 year.

TO PROTECT MEADOW WATERWAYS AND TERRACE FLOW LINES

Meadow waterways are preferably seeded to perennial vegetation, but annual lespedeza serves as a great help in desilting and in preventing cutting during summer (fig. 24). On gentle slopes the stubble is also a rather effective desilter. Terrace flow lines are often filled with silt when a heavy volume of water comes down cultivated slopes above the terrace. To remove the silt before the water reaches the flow line, annual lespedeza may be seeded for 8 to 10 feet above the flow line, on the terrace, and for several feet on the down side of the terrace. This filter strip will prevent the rapid silting of the terrace flow line.

FIGURE 24.—Kobe lespedeza in a waterway meadow.

USE IN PASTURES

The use of lespedeza for grazing has been adequately discussed, but it should be emphasized that it best serves as a soil-conserving crop when used as pasturage and that it is probably the most widely useful and productive leguminous pasture plant in the South. Lespedeza should be included in all permanent-grass mixtures on fair to medium soils. It covers the bare spots usually found in grass sod, and it helps to prevent erosion. The use of pure lespedeza pasture during midsummer and early fall months when grass pasture is poor or dormant saves permanent grass pasture from damage. Small gullies in pastures can be healed and further erosion stopped by seeding lespedeza.

Wherever Bermuda grass does well, lespedeza should be seeded with Bermuda grass as this will tend to minimize soil loss in winter. The combination of lespedeza with perennial grasses such as Kentucky bluegrass and redtop will succeed on the better soils, but it is doubtful whether on some soils low in organic matter a good sod of perennial grasses can be maintained under the competition of lespedeza. Even without the lespedeza the grasses suffer from heat, drought, and trampling during summer. Lespedeza thrives under such conditions and tends to crowd out the weakened grass.

A winter annual grass that will reseed and give way to lespedeza for the summer will probably be more satisfactory. Such a combination is being successfully used in north-central Tennessee where *Bromus japonicus* makes good late-winter and early-spring grazing, reseeds, and gives way to lespedeza. Such a combination may prove to be much more successful than the attempt to get permanent grass and lespedeza on the same field of worn soil. Wherever a permanent pasture of bluegrass, redtop, and white clover is preferred and is practicable, it will almost surely be more profitable to move the cattle to a pure lespedeza pasture for the midsummer months.

Such a pure lespedeza pasture will keep in good shape longer and be freer from weeds if grain is drilled into the disked lespedeza stubble every fall. Besides the good effect on the lespedeza, the grain will furnish some early spring grazing and the cash grain some additional revenue.

LITERATURE CITED

(1) BLAIR, E. C.
1933. LESPEDEZA IN NORTH CAROLINA. N. C. Agr. Col. Ext. Cir. 195, 8 pp., illus.

(2) BRANNER, C. O.
1934. FORAGE, HAY, AND PASTURE. Ark. Agr. Expt. Sta. Bull. 297 (Ann. Rept. 45): 53–63.

(3) BUCKNER, G. DAVIS, INSKO, W. M., Jr., MARTIN, J. HOLMES, and HARMS, AMANDA.
1937. THE VALUE OF LEAF MEALS OF ALFALFA, KOREAN LESPEDEZA AND LESPEDEZA SERICEA IN ALL-MASH CHICK RATIONS. Ky. Agr. Expt. Sta. Cir. 48, pp. [27]–31.

(4) DODSON, W. R., MORGAN, L. E., GLADNEY, E. L., CATLETT, K. T., MCKAY, K., SMITH, A. L., and others.
1911. LESPEDEZA OR JAPAN CLOVER. La. Agr. Expt. Sta. Bull. 130, 64 pp., illus.

(5) Dworak, Mayme.
1916. lespedeza seed. La. Agr. Col. Ext. Cir. 11, 11 pp.
(6) Essary, S. H.
1921. lespedeza (japan clover). Tenn. Agr. Expt. Sta. Bull. 123, 28 pp., illus.
(7) ———
1928. control of dodder in lespedeza. Tenn. Agr. Expt. Sta. Cir. 22, [2] pp.
(8) Etheridge, W. C., Helm, C. A., and King, B. M.
1930. korean lespedeza in missouri. Mo. Agr. Expt. Sta. Bull. 280, 14 pp., illus.
(9) ——— and Helm, C. A.
1936. korean lespedeza in rotations of crops and pastures. Mo. Agr. Expt. Sta. Bull. 360, 22 pp., illus.
(10) ——— Helm, C. A., and Brown, E. M.
1937. an all-year pasture system for missouri. Mo. Agr. Expt. Sta. Cir. 193, 12 pp., illus.
(11) ——— and Helm, C. A.
1938. wheat in missouri. Mo. Agr. Expt. Sta. Bull. 398, 41 pp., illus.
(12) Gish, P. T., and Hutcheson, T. B.
1933. field crops on berks shale soil respond to lime and fertilizers. Va. Agr. Expt. Sta. Bull. 292, 29 pp., illus.
(13) Grinnells, C. D.
1935. lespedeza and alfalfa hay for dairy cows. N. C. Agr. Expt. Sta. Bull. 302, 21 pp.
(14) Holdaway, C. W., Ellett, W. B., Eheart, J. F., and Pratt, A. D.
1936. korean lespedeza and lespedeza sericea hays for producing milk. Va. Agr. Expt. Sta. Bull. 305, 7 pp.
(15) Illinois Agricultural Experiment Station.
1933. good soil treatment will pay even with lespedeza. Ill. Agr. Expt. Sta. Ann. Rept. 46:20–22, illus.
(16) Kenney, Ralph.
1932. korean lespedeza. Ky. Agr. Col. Ext. Cir. 258, 23 pp., illus.
(17) Kentucky Agricultural Experiment Station.
1935. feed control. Ky. Agr. Expt. Sta. Ann. Rept. 48:56–58.
(18) Kinney, E. J., Kenney, Ralph, and Fergus, E. N.
1937. the lespedezas in kentucky. Ky. Agr. Col. Ext. Cir. 297, 23 pp., illus.
(19) Lloyd, E. R.
1915, feeding value of different kinds of hays. . . Prog. Farmer 30 (22):8.
(20) Middleton, Gordon K.
1933. hard seed in korean lespedeza. Jour. Amer. Soc. Agron. 25:119–122.
(21) Miller, H. A.
1934. farm practice with lespedeza. U. S. Dept. Agr. Farmers' Bull. 1724, 18 pp., illus.
(22) Mooers, C. A.
1930. the effects of various legumes on the yield of corn. Tenn. Agr. Expt. Sta. Bull. 142, 16 pp., illus.
(23) Moore, J. S.
1925. importance of home grown feeds. Miss. Agr. Expt. Sta. Ann. Rept. 38:17–18.
(24) ——— and Cowsert, W. C.
1926. soybeans for dairy cows. Miss. Agr. Expt. Sta. Bull. 235, 15 pp., illus.
(25) Morrison, F. B.
1936. feeds and feeding; a handbook for the student and stockman. Ed. 20, unabridged, 1050 pp., illus. Ithaca, N. Y.
(26) Nevens, W. B.
1934. lespedeza straw for dairy cows. Jour. Dairy Sci. 17:671–674.
(27) ———
1935. lespedeza hay for dairy cattle. Jour. Dairy Sci. 18:593–598.
(28) North Carolina Cooperative Crop Reporting Service.
1938. farm census survey summary for north carolina, 1936 and 1937. N. C. Crop Rptg. Serv. Farm Forecaster 77:6.

(29) PATRICK, C. S.
1933. LESPEDEZA AS A SOIL BUILDER. S. C. Agr. Expt. Sta. Ann. Rept. 46: 120–121.

(30) PEELE, T. C.
1935. REPORT ON SOIL EROSION INVESTIGATIONS. S. C. Agr. Expt. Sta. Ann. Rept. 48: 25–28, illus.

(31) PIEPER, J. J., SEARS, O. H., and BAUER, F. C.
1935. LESPEDEZA IN ILLINOIS. Ill. Agr. Expt. Sta. Bull. 416, pp. [297]–347, illus.

(32) PIETERS, ADRIAN J.
1934. THE LITTLE BOOK OF LESPEDEZA. 94 pp., illus. Washington, D. C.

(33) ———
1939. SERICEA AND OTHER PERENNIAL LESPEDEZAS FOR FORAGE AND SOIL CONSERVATION. U. S. Dept. Agr. Cir. 534, 44 pp., illus.

(34) ——— and VAN ESELTINE, G. P.
1924. KOREAN LESPEDEZA: A NEW FORAGE CROP. U. S. Dept. Agr. Dept. Cir. 317, 15 pp., illus.

(35) RUSK, H. P.
1935. TANKAGE MAKES GOOD AS A CATTLE FEED. Natl. Livestock Prod. 13 (4): 3, 13, illus.

(36) STITT, R. E.
1934. A COMPARISON OF THE DRY MATTER CONTENT OF ANNUAL LESPEDEZAS, ALFALFA, AND SOYBEANS. Jour. Amer. Soc. Agron. 26: 533–535.

(37) TENNESSEE AGRICULTURAL EXTENSION SERVICE.
1936. FALL GRAIN ON LESPEDEZA SOD. Tenn. Agr. Col. Ext. Pub. 189, folder, illus.

(38) TYSDAL, H. M., and PIETERS, A. J.
1934. COLD RESISTANCE OF THREE SPECIES OF LESPEDEZA COMPARED TO THAT OF ALFALFA, RED CLOVER, AND CROWN VETCH. Jour. Amer. Soc. Agron. 26: 923–928.

(39) UNITED STATES BUREAU AGRICULTURAL ECONOMICS.
1936. HANDBOOK OF OFFICIAL HAY STANDARDS. 62 pp.

(40) ———
1936. SEED STATISTICS. 58 pp.

(41) ———
1936–38. CROPS AND MARKETS. v. 13–15.

(42) WASSON, R. A.
1935. LESPEDEZA. La. Agr. Col. Ext. Cir. 158, 7 pp.

(43) WEATHERS, E. K.
1938. MINERAL AND NITROGEN CONTENT OF LESPEDEZAS AND OTHER CROPS IN TENNESSEE. Tenn. Agr. Expt. Sta. Bull. 166, 32 pp., illus.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE WHEN THIS PUBLICATION WAS LAST PRINTED

Secretary of Agriculture	Henry A. Wallace.
Under Secretary	M. L. Wilson.
Assistant Secretary	Harry L. Brown.
Director of Information	M. S. Eisenhower.
Director of Extension Work	C. W. Warburton.
Director of Finance	W. A. Jump.
Director of Personnel	Roy F. Hendrickson.
Director of Research	James T. Jardine.
Director of Marketing and Regulatory Work	A. G. Black.
Solicitor	Mastin G. White.
Land Use Coordinator	M. S. Eisenhower.
Office of Plant and Operations	Arthur B. Thatcher, *Chief.*
Office of C. C. C. Activities	Fred W. Morrell, *Chief.*
Office of Experiment Stations	James T. Jardine, *Chief.*
Office of Foreign Agricultural Relations	Leslie A. Wheeler, *Director.*
Agricultural Adjustment Administration	R. M. Evans, *Administrator.*
Bureau of Agricultural Chemistry and Engineering.	Henry G. Knight, *Chief.*
Bureau of Agricultural Economics	H. R. Tolley, *Chief.*
Agricultural Marketing Service	C. W. Kitchen, *Chief.*
Bureau of Animal Industry	John R. Mohler, *Chief.*
Commodity Credit Corporation	Carl B. Robbins, *President.*
Commodity Exchange Administration	J. W. T. Duvel, *Chief.*
Bureau of Dairy Industry	O. E. Reed, *Chief.*
Bureau of Entomology and Plant Quarantine	Lee A. Strong, *Chief.*
Farm Security Administration	W. W. Alexander, *Administrator.*
Federal Crop Insurance Corporation	Leroy K. Smith, *Manager.*
Federal Surplus Commodities Corporation	Milo R. Perkins, *President.*
Food and Drug Administration	Walter G. Campbell, *Chief.*
Forest Service	Ferdinand A. Silcox, *Chief.*
Bureau of Home Economics	Louise Stanley, *Chief.*
Library	Claribel R. Barnett, *Librarian.*
Division of Marketing and Marketing Agreements.	Milo R. Perkins, *In Charge.*
Bureau of Plant Industry	E. C. Auchter, *Chief.*
Rural Electrification Administration	Harry Slattery, *Administrator.*
Soil Conservation Service	H. H. Bennett, *Chief.*
Sugar Division	Joshua Bernhardt, *Chief.*
Weather Bureau	Francis W. Reichelderfer, *Chief.*

This circular is a contribution from

Soil Conservation Service	H. H. Bennett, *Chief.*
Bureau of Plant Industry	E. C. Auchter, *Chief.*

U. S. GOVERNMENT PRINTING OFFICE: 1939